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NATIONAL STATISTICS IN WAR AND PEACE.*

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Our national participation in the war has brought with it an enormous demand for prompt and exact statistical information. Such a demand is, of course, an inevitable accompaniment of a war waged under modern conditions. War has come to be a conflict of directed masses,—of aggregates. Men, money, munitions, food, railways, shipping, raw materials, and manufactured products in great variety are impressed into the service of the nation. The problems of the effective control and use for war purposes of these varied national resources is intimately dependent upon a knowledge of their quantities, that is, upon statistics. Like chemistry, physics, and the applied sciences, statistical knowledge and the statistical method have come to be important tools of modern warfare. Just as this war is our largest national undertaking, so its statistical demands constitute, in the aggregate, the largest statistical problem with which we have had to deal.

The statistical activities of the federal government in times of peace cover in the main only those phases of national life which are deemed to be of public and especially of political moment. Our census of population is taken primarily to afford a basis for congressional apportionment; our census of manufactures and our foreign trade statistics still bear the marks of tariff controversies, and our federal statistics of wages and prices may be traced back to the same origin. In other fields, as diverse as immigration and railway transporta-

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tion, our federal statistics are at once a by-product of federal control and a guide in the exercise of that control. In the fields of federal finance, money, and banking, our statistics are largely administrative by-products. The statistical work of the Department of Agriculture is a recognition, inadequate as yet, of a public interest which is probably only in small part political, and so with the statistical work of the Geological Survey and the Bureau of Mines. The work of the Bureau of the Census in the field of vital statistics is the most noteworthy example of the recognition of a large social interest which is not primarily either economic or political.

Thus the federal government, in its statistical work, has touched the current of our national life at only relatively few points, and at some of these only intermittently. For the most this current flows on in its own channels, free from disturbance or questioning or measurement by the government. Except to the tax-gatherer, a large part of the productive and business activities of the country have not been deemed to be matters of public concern, even as group aggregates.

The changes brought by our entrance into the war have been profound. Other activities have had to be subordinated to the necessities of the efficient and successful conduct of the war. This subordination, we may well believe, is only imperfectly realized as yet. If the war continues it is certain that the field of activity over which the public interest will be deemed to extend must be much further widened.

Our national problem, in its essence, is that of directing our efforts and output into new channels, of focusing all of our national energies on the one supreme task before us. Individual desires and whims are no longer masters of our economic life. Instead of doing what it is most profitable to do, men are beginning to do, and to do willingly, what they are bidden to do.

This new ordering of life works through such diverse forms as the drafting of men, the commandeering of ships and workshops and supplies, the control of prices and output, the restriction of exports and imports, the supervision of the processes of market distribution, the regulation of consumption, the coördination and administration of transportation

agencies, the solution of labor difficulties, the raising of vast sums of money through taxes and loans, and the creation of priority rights.

The successful execution of such a program calls for a degree of national self-knowledge far beyond anything that we might have imagined necessary or possible in the past. We have been suddenly thrust into a situation in which we find ourselves in urgent need of a complete inventory of our national assets and a complete record of our productive activities. In this need we find the explanation of that enormous demand for prompt and exact statistical information to which I have referred.

In this emergency we turned first to our existing stocks of statistical information and to the current statistical output of our government bureaus, and have realized, perhaps for the first time, how woefully incomplete and inadequate our federal statistics are. With our latest population figures seven years old, our latest statistics of manufacturing output three years old—and it is surprising to find how antiquated and how useless for present purposes this latest manufacturing census is—and with no information whatever respecting important fields of trade, we were in a state of statistical unpreparedness.

Under these conditions a war statistical service had to be improvised. With no centralizing and coördinating agency at work, the boards and commissions created to take charge of the various fields of war work have had to procure for themselves, as best they could, the statistical information needed for their purposes. In part, it is true, these inquiries have taken the form of assembling information furnished by other organizations, and more especially by the permanent statistical offices of the government. But there is scarcely a war board or commission in Washington that has not had to make independent statistical investigations of its own, involving the collection, tabulation, and analysis of necessary facts. In many instances this work has been of sufficient magnitude to lead to the organization of separate statistical bureaus or divisions within these war organizations. A few of these rival in the size of their staffs and of their statistical output the larger of the permanent statistical offices.

I shall not attempt to describe in any detail the work of these new statistical agencies. Hurriedly organized, confronted by really formidable tasks and by the necessity of getting quick results, it was inevitable there should have been much misdirected energy. In particular there has been, admittedly, much duplication of inquiries. Each war organization, needing information of a kind not immediately available, has very naturally proceeded to obtain it at first-hand by direct investigation and inquiry. Because there is a large measure of overlapping in the statistical needs of the different war organizations there has been some overlapping of inquiries. Business men and trade organizations have found themselves required to furnish information, essentially similar, but with just enough differences to require the work to be done over again, for two or more Washington offices. These wastes are now becoming smaller, as a result of increasing knowledge on the part of each war organization of the activities of others. A less excusable form of duplication has come from the neglect on the part of some of the new organizations to inform themselves fully respecting the work of the established statistical bureaus, or, at any rate, from their failure to make use of the material that these permanent bureaus might easily have furnished them.

As for the work of these permanent bureaus, out of my own experience in the work of one of the war organizations, I can vouch for their unfailing attitude of helpful and generous coöperation. Certain of them, in fact, have taken on heavy additional burdens in this way. Thus one may cite the more adequate and more promptly published statistics that are now available for the production of minerals and metals, and the prompter tabulation of foreign trade statistics. These are merely examples, for there is hardly a statistical bureau in Washington that has not been called upon for some new or increased service. It must nevertheless be said that some of these bureaus have not risen to the full recognition of their opportunities. With so much that needs to be done, and so much that is being badly done by others by reason of insufficient experience or inadequate equipment, some of our permanent bureaus are giving virtually all of their energies to

routine work, much of which is of relatively little present importance, or are merely marking time.

What I have just said should not be taken as imputing any blame to the men who are immediately responsible for the policies of these bureaus. Most of them are handicapped by inadequate appropriations and find it difficult for that reason to arrange for any considerable increase in their functions. And in many instances the available appropriations are for specific purposes and cannot be transferred to new undertakings. Not only has it been easier to obtain funds for the new war offices than for the established organizations, but the new offices have been encumbered by fewer restrictions respecting the precise way in which they should use their funds. In this way they have virtually been compelled to do for themselves what might, in many cases, have been more economically and efficiently done by one or another of the permanent statistical bureaus. In statistical work, as in other fields of government activity, the new war organizations have been superadded to the preëxisting administrative machinery rather than merged with it,—a policy which has its disadvantages as well as its advantages.

Returning now to the topic of the work which has been done and which remains to be done by the different war statistical bureaus, it is to be observed that despite the differences in their tasks, a common thread of interest runs through their work. They are all concerned, fundamentally, with the general tasks which I have mentioned earlier in this discussion: the measurement of our national resources, whether in men, money, or goods; the determination of our actual and potential output of the immense variety of things that are important, directly and indirectly, in the conduct of the war; the gauging, so far as may be, of our own needs and those of our allies and of the other countries that have to be recognized as in some measure dependent upon us. The problems of raising and equipping a fighting force, of providing ships and munitions, of food and fuel control, of the regulation of exports and imports, of the organization of transportation, of industrial priority, of the adjustment of labor difficulties, of national economizing, and of war finance, are all inextricably interwoven. Back of all

these special problems is the general problem of the relative urgency of different national needs,—the problem of priority in the widest sense. Here not only successful administration but even the right choice of policies depends upon full and accurate knowledge, and in particular upon statistical knowledge.

It is partly, perhaps, because this statistical problem is usually discussed in terms of its parts, rather than as a whole, that its enormous importance has not been fully realized. When compared with our aggregate annual expenditures for war purposes, our expenditures for statistical purposes are seen to be almost pitifully inadequate. It is easy to see the wastes and the duplications in such statistical work as has been done. It is harder, perhaps, to realize the indispensable character of most of this work. It is even harder to visualize the real advantages and economies that would result from the organization of statistical inquiries on a vastly greater scale than now obtains.

Many of the mistakes that have been made—and some of them have undoubtedly been very costly—have been due to the lack of full and exact statistical information. Our expenditures for statistical purposes are not a thousandth part of our aggregate war expenditures. It might easily be wise economy to increase them ten or twenty fold. This much at least is certain: in range, in completeness within the fields which they cover, and in accuracy, the statistics now available furnish a wholly inadequate basis for the most efficient conduct of the task in hand. Our statistical apparatus has not expanded in any such degree as the field of public interest has grown. Confronted as we are by the necessity of making the most effective disposition of our national energies, we have not attempted to secure anything like a complete and accurate statement of the forces at our disposal. In some special fields our knowledge may be fairly complete, but in other fields it is either incomplete or non-existent. Most of all we lack the materials for a picture of the whole economic situation, invaluable as it would be as an aid in the shaping of national policies.

To make the point clear, imagine, if you will, what might have been accomplished if, when we entered the war, or even

when our participation in the war came to be a serious possibility, there had been created a central statistical commission, instructed to develop a scheme for a comprehensive war statistical service. In the light of the experience of the other belligerents—for there are few elements of novelty in our own war problems—the greater part of our statistical needs might have been foreseen. Plans for the utilization and extension of the work of existing statistical bureaus, as well as for the creation of new ones for special purposes, would very likely have been made. To begin with, there would have been a complete census of population, with inquiries respecting sex, age, marital condition, citizenship, nationality, occupation, and income. The schedule would have been simple and the tabulations would have been merely those which threw direct light upon the problems in hand. Among other things this would have afforded a definite basis for a genuinely selective draft and for the right construction of a war income tax. Then there should have been a general census of production, covering extractive as well as manufacturing industries, especially for the whole field of staple products, neglecting some of the customary inquiries, but putting special stress on such points as stocks and consumption of raw materials, stocks and output of finished products, capacity, existing contracts—foreign and domestic—and number of employees. Similar inquiries might advisably have been made in the field of market distribution, at least so far as the wholesale, jobbing, brokerage, commission, and storage trades are concerned.

In the second place, provision should have been made for keeping much of this information up to date, through some system of weekly or monthly reporting, thus doing for important fields of industry and trade what is already done for agriculture and mining. The population census, even, might well have been used as a starting point for continuous local population registers, under the charge of the police or of local registration officials. In all of this work it would be sufficient if the general tabulations showed classes only, but information respecting individuals and firms ought to be available, by means of proper formalities, to the appropriate branches of the war administration.

This may seem to be an ambitious statistical program, but, in view of the unprecedented magnitude of the interests involved, it is perhaps unduly modest. Certainly it would have to be supplemented, in any adequate scheme, by provisions for a more elaborate centralization of statistics of railway operations and of the general movement of goods, for very much more detailed statistics of foreign trade than we now have, for more comprehensive official records of wages and prices, and for the compilation of all available statistics bearing upon economic conditions in other countries. I have left out of account the enormous mass of information that has to be gathered with reference to individual persons and firms and transactions, rather than to groups or aggregates, as primarily non-statistical in character. I have also omitted reference to the use of statistics in purely military operations, as a subject apart. It may be worth noting, however, that Napoleon put as much emphasis upon the value of complete statistics as a basis for military strategy as he did upon their use in the administration of civil affairs.[1]

Under such a scheme of organization as I have in mind the central statistical commission would have other functions than that of planning and apportioning the work to be done. It would remain as a centralizing and coördinating body, a clearing house for the national war statistical service. As new statistical demands arose they would be referred by it to the bureaus best qualified to secure the desired information. It would confer with the organizations asking for statistical service and with the bureaus furnishing this service respecting such practical matters as the best construction of schedules and the best tabulation of returns. Upon it would devolve the duty of making synthetic statistical studies of the whole national situation, the importance of which I shall try to indicate later.

I hope that I shall not be interpreted as meaning that no separate war statistical organizations should have been created, that all of the work should be done by established bureaus under the general direction of the suggested central commission.

[1] Cf. A. de Foville, *Napoléon Statisticien*, in Journal de la Société de Statistique de Paris, December, 1911.

This would be manifestly undesirable and impossible. Some war organizations need statistical divisions for compiling and tabulating the records of their own activities. Some of them need special statistical inquiries or special statistical information that is of importance and interest only to themselves. In many instances, too, statistical material, wherever obtained, has to be combined and organized so as to meet the special needs of a particular organization.

The purpose of the suggested central commission would be, not to displace, but to coördinate and especially to supplement such statistical work as would naturally and necessarily be done if no such commission existed. Nor is the matter of economy through avoidance of duplication the most important factor. The inevitable duplication of work on the part of bureaus that are concerned primarily with their own particular problems is a matter of relatively small moment compared to the fact that no number, no matter how large, of isolated bureaus will adequately cover the whole field of necessary statistical information, so far as that field is one in which their interests are common. Each separate organization may cover the field in which its own interests are special, but this is no guarantee that it will be able to find anywhere or to provide for itself such fundamental statistics as are of common interest to itself and to other organizations.

The difficulties under which war statistical work has been carried on in Washington have come very largely from the absence of any organization with power to formulate the statistical problem as a whole. But apart from the particular advantages which the existence of this fundamental general statistical information would give to the separate branches of the war administration, there is the yet larger gain that would come from a comprehensive view of our national assets, and more especially of our annual national product. This kind of view is essential to the wisest national strategy, to the most effective use of our available powers. Only in this way can we find the materials for an estimate of our possible national savings,—not in terms of money, but of labor and resources and goods. Only in this can we gauge the maximum amount that the government may wisely spend for war

purposes as indicated by the part of the national product and of the national productive forces that it can divert to its own uses. Such a statistical survey would indicate not only the foods, but also the raw materials, finished products, and classes of productive agents of which the supply is short as well as those of which there is a surplus. It would suggest, at least, where national waste exists. In short it would point the way, as I have already suggested, to the most effective marshalling and redistributing of all of our national energies.

To summarize: Our governmental statistical work has been largely concerned with such affairs as have happened to be matters of public or political concern. War not only enlarges the field of public interest, but it also creates a new set of values. These new values are not the outcome of the "normal forces of supply and demand," but are, or should be, the expression of conscious decision respecting the relative worth of different things and different activities for the dominant national purposes. These values can be effectively recognized and expressed in action only on the basis of a far more comprehensive mass of statistical information than has been available or is likely soon to be available. A practicable if not the only method of planning for and obtaining these statistics on an adequate scale is through the agency of a central statistical commission. The cost, however great, would be small as compared merely with the magnitude of the economic problems dependent for a right solution upon the knowledge such statistics would give, and wholly negligible in view of the larger interests involved.

What light does this review of the problem of statistical organization in war time throw upon the problem of statistical organization in time of peace?

It is not to be presumed that after peace is to be concluded we shall continue to want precisely the sorts of statistics that are now needed, that the field of public interest will be wholly unchanged. Nor is it to be presumed that we will be interested, as a nation, in just the things that were deemed most important before the war. The boundaries of the field of public interest will be narrower, undoubtedly, than they now

are, but they will not be just what have been in the past. The lapse back from a thoroughly awakened national consciousness will not be complete. However large the measure of freedom restored to individual enterprise and to the individual conduct of life, we shall realize, as we have not in the past, the possibilities of doing things on a national scale, of rationally adapting the mechanism of national life to fit national ends. And there will be new national interests springing from our new participation in world affairs. There will be, in short, new fields of statistical inquiry.

It is possible that there will not be a ready and general acceptance of a premise implicit in what I have said: namely, that the organization of national statistics should, in fact, correspond in scope to the field of public interest. Is no weight to be given, it may be asked, to purely dispassionate and scientific interests? I confess to being somewhat skeptical with respect to the reality of a what is sometimes appropriately called "idle scientific curiosity." There is an interest in technique and there is an interest in problems, and may it not be that our "idle scientific curiosity" is merely a name for an interest in technique strong enough to make the choice of problem a matter of indifference. But without venturing further on disputed and dangerous ground one may safely observe that the function of a national statistical service is primarily that of securing and purveying statistical information; that is, in a large sense, of answering questions and of providing the material for the solution of problems. As statisticians I fear that we have sometimes permitted our interest in technique to blind us to the social importance of the right choice of the problems to be covered in our federal statistical service. There is much satisfaction to be derived from doing our best with bad statistical material, from replacing the missing facts by careful inference and shrewd conjecture. One can even sympathize with the scholar who complained that the modern wealth of printed bibliographies had destroyed scholarship. But as a guide to the choice and administration of national policy, verifiable facts are infinitely better than estimate and conjecture. If statistics is not to be merely an occult science, statisticians must interest them-

selves in enlarging the scope of their sources of information and particularly in what we may describe as the national choice of statistical problems.

Although before the war our national statistical activities could be explained in terms of past and present phases of public interest, it can not be said that all important phases of public interest were adequately represented. Even then, I think we shall all admit, our national statistical service had not kept pace with the fast-flowing current of economic and social change and with the accompanying development of new national interests. And with yet more profound changes impending in the near future, some form of method of statistical reorganization and adjustment will be urgently needed. This is because, in general terms, the formulation and administration of wise national policies must depend upon the national self-knowledge that only statistical information, gathered on a much larger scale than we have been accustomed to think possible, can give. Nor must the importance of an elastic and comprehensive scheme of statistical organization as an element in preparedness for war be forgotten.

A committee of this Association, coöperating with committees of other associations, has been studying the problem of the organization of statistical work in Washington. I am informed that it has given favorable consideration to proposals looking toward the creation of a central statistical commission. It is to be hoped that its efforts will help to secure tangible progress toward that end. But the functions of such a commission ought to include more than merely introducing some measure of coördination into the work of the existing Washington offices. It should be empowered to make recommendations to Congress for the inauguration of new statistical activities, utilizing either established offices or new ones, according to the circumstances of the particular case. It should control some discretionary funds, to be used in special inquiries made by its own staff or, more frequently, by one or more of the established statistical bureaus. Its fundamental interest should be less in the statistical work that is being done than in the work that is not being done. It should try to eliminate some of the statistical dead wood that now cumbers

the reports of many of the Washington bureaus. It should not refrain, even, from attempting to introduce an element of national prophecy as well as of national history into our statistics.

If the statistical problems brought sharply into the foreground by the war hold any lesson that has a significance for times of peace, it is that we have not yet begun to realize the possibilities of federal statistics as a general scheme of national accountancy, or the responsibilities which the future holds for the statistician.

STATISTICAL UNITS AS STANDARDS.*

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I. INTRODUCTION.

The requirement that statistics shall be comparable and the employment of statistical methods scientific is no less important, although it is undoubtedly more urgent, in times of war than of peace. We may hope for an end to war but we cannot expect the demands of statistical usage to be any less exacting. Never before has there been the same need as at present for an evaluation of accepted institutions, beliefs and methods, and for an appraisal of the rôle which statistical science is to play in the solution of world problems. Approximations, loose thinking, false judgments, crude comparisons, the mistaking of cause for effect, etc., because of ignorance, prejudice or a wilful desire to deceive, seem forever to be condemned in the searching criticism of realities which has come to us with the war.

Few fields of public or private activity seem to have escaped the demand for the creation of new standards. In the so-called scientific world, the slow processes of adjustment to new and changing conditions seem recently to have been greatly accelerated. In the business world where standards of measurements, uses, activities, etc., have not already been fixed and installed, either competition or state regulation is forcing their adoption. The scientific approach to economic and social problems seems to have caught public attention. Accounting has had its meteoric rise during the last decade and its cost aspects are rapidly coming into their own. The aim is clearly the introduction of scientific method, the appraisal of differences and similarities, the determination of cause and effect, all with the purpose of adjusting the processes of private and public business to the particular demands and needs of time and place.

The development of statistical methods in the interpreta-

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tion of biological phenomena has been rapid. In the fields of business and social science, however, the growth has been slower, and of a more uncertain and unscientific type. Only recently has the popular assumption been in part dispelled that by "statistics" one can "prove anything." Even now the position of statistical methods is not secure nor are the uses to which statistics are put above serious criticism outside the laboratories and research fields of statistical students, the statistical departments of some of the more advanced government bureaus, and the more progressive private businesses. Statistical surveys and even statistical departments, in private and public business, are common, but that statistics are more than records of past activities,—collected not because of their relationship to future policy but rather because they are "comparable" with those already at hand—and that they may be made to supplement accounting in the formulation of rules and principles for future guidance, unfortunately have not become generally felt. Their present position is similar to that occupied by accounting ten years ago. People are not completely nor universally converted to the wisdom of their use, nor are they fully cognizant of the extent of their application.

The prejudice against both statistics and statistical methods, in part at least, is due to the following tendencies:

(1) To accept without serious question a plausible description of a given condition or state of affairs. *Ipse dixit* is often regarded as sufficient proof. The mere fact of statistics appearing in print, and particularly of their being in tabulated or graphic form—the finality of a statistical table or graph is often magical—is frequently sufficient to insure their value and to guarantee their application.

(2) To employ statistical data without knowledge of, or regard for the units of measurements in which they are expressed, or their comparability or representativeness, and to draw conclusions from them which they were never intended to support.

(3) To disregard detail, or to regard it as "detail" which somehow will take care of itself and needs no especial attention, to ignore statistical cautions respecting the collection of

data or the use of those already collected, to speak in terms of statistical abbreviations, averages of all types, to employ totals as if they were always more sacred and inviolate than the items which go to make them up, and to piece together statistical fragments, gleaned from different sources and compiled under widely different circumstances, into a beautiful mosaic which thoroughly proves or disproves a contention already held.

(4) To fail to formulate the purposes of statistical studies, to outline appropriate methods in order to serve the ends desired, to define with precision the units employed in the measurements, and rigidly to limit the field to be covered.

Statistics do not answer questions nor support conclusions independently of those who manipulate them. Judgment, candor, and integrity in their use are necessary at every step. The scientific development of statistical methods depends not only upon these but also upon a full realization of the meaning and function of units of measurements. It is statistical units as standards with which I shall deal in this brief paper.

II. UNITS AND STATISTICAL METHODS.

The statistical approach is numerical. Things, attributes, and conditions are counted, divided, subdivided, totalled and combined. Statistics are in large measure synthetic. They deal with aggregates, rather than single instances or rare occurrences. These, however, relate to units of measurements characteristic of things or conditions studied and apply to definite uses. It is not 1,000 as an abstract unit of frequency which is considered, but 1,000 farms, industrial establishments, loans, mortgages, etc. Numbers as abstract units may be combined, separated and divided because they are homogeneous, the more or less merely indicating presence or absence of a condition represented abstractly. But this is not true of units of measurements dealt with in statistics. The physical measurements of the unit "ton-mile," for instance, remain constant; but the qualities of the unit vary with each purpose for which it is used. A ton is invariably a ton and a mile a mile, but all tons, except as to weight, are not the same, nor are all miles, except as to length, equivalent. The problem

of enumeration is not so much that of counting units describing different degrees of intensity, abundance or absence of the same thing, as it is of counting different things which have been given the same general name. Things which are equal to each other in name are often not so in use. Standardization implies homogeneity; it suggests conformity and suitability to conditions determined in the light of particular application. The meaning of a statistical unit is a function of the use to which it is put. An illustration will give point to this contention.

It is desired to determine the industrial accident rate in a given industry as a basis for fixing a scale of compensation. What is an accident? The reason for compensation is the consequences of personal injury and it is the character of the injury which serves as a basis for enumeration. All injuries involving a loss of any time howsoever slight might be thought worthy of inclusion. But since compensation is the occasion for the determination of the number, only those injuries should be included which cause an *appreciable* loss of time. What is an appreciable loss of time? To an individual who experienced the loss, it might be any time, howsoever slight. To the employer, however, who advances the compensation, and to the public who finally bears it, a period of one or two weeks might be thought to be the minimum compensable period. But many trifling accidents may occasion a far greater loss of time than a single or a few serious ones. There would be no hesitancy about counting the serious, yet there might be respecting the minor ones. But it is precisely the latter which frequently can most easily be prevented, and about which information may be desired, since precautionary measures involving little added cost to the employer, increased efficiency to the employee, and the gradual elimination of the occasion for compensation, may be taken for their eradication.

Moreover, only industrial accidents are to be compensated. Self-inflicted injuries as well as those occurring to workmen while not engaged in industrial operations, and when work done is not a proximate cause of injury, should be eliminated, when accidents are enumerated for this purpose. Moreover, is disease contracted directly as a result of the conditions of industry an accident? Surely it is an "injury," and if injury

is the basis of compensation, ought not disease of this type to be counted in determining upon a reasonable basis? If disease contracted directly as a condition of employment is counted as an industrial injury (not "accidental," but characteristic or regular), how should instances involving impairment of health, mental or physical ability, be considered? How long a period must elapse before a condition, the result of employment, ceases to be checked against such employment? What is an industrial accident for compensation purposes?

On the other hand, if the purpose of enumerating industrial accidents were to measure the amount of time lost through mental or physical injury, obviously, all accidents and all diseases directly attributable to industry should be included. If the purpose were solely to secure information as a basis for removing the conditions causing accidents, or for assigning responsibility for them as between employer and employee, machine and injured person, those which were trivial, from the point of view of the individual, would take equal rank with those denominated severe. What is an industrial accident?

To formulate the purposes for which statistics are to be collected and used is the first step in statistical analysis; rigidly and unmistakably to define the units of measurements in which aggregates are expressed and to adhere to them throughout the process, is the second. The latter is governed by the former, as the former is determined by the latter. The two are reciprocal. Statistical units cannot be defined outside of the purposes of their employment, nor the purposes fully realized without the use of definite and standardized units of measurements.

The foregoing discussion will serve to make clear the distinction between the use of mass or frequency concepts in pure mathematical calculations and the use of the same concepts when associated with statistical units. Statistics is more than arithmetic. Numerical considerations and preponderance of evidence are the bases for statistical conclusions, but to arrive at them more than numerical computations are involved. It is concerned with the processes and methods of formulating and testing conclusions from premises resting upon numerical bases.

Leaving this more general discussion of the relationship of statistical units to the purposes for which they are used, certain types of units may be distinguished, and some of their peculiarities noted.

III. TYPES OF STATISTICAL UNITS OF MEASUREMENTS.

Distinction is drawn between *units of enumeration and estimation* and *units of analysis and synthesis*. The first are those by means of which statistics are collected; the second, those by means of which statistics are interpreted. The former are related more to statistics as numerical facts; the latter, more to statistics as methods in the use of these facts.

1. *Units of Enumeration and Estimation.*

Units of enumeration and estimation may conveniently be divided into two classes, *simple* and *composite*. By simple units are meant those in which one determining consideration is prescribed. Most statistics of enumeration employ simple units, as, for instance, where persons, animals, acres, etc., are counted or estimated. In units of this type the conflict between identity and use is reduced to a minimum. They are simple and this fact normally guarantees against the presence of as great a degree of error as is associated with units which are composite in character. The unit "farm," for instance, for a given purpose, might be easily defined and the statistics of "farms" readily understood. When, however, the limiting word "improved" is added, both the scope of the unit and its application are noticeably restricted. The additional element is as subject to error as is the root portion of the combined unit. Crops in bushels or in acreage may be readily determined; to establish the "normality" of these crops, however, raises other problems and calls for superior statistical organization and for a much greater exercise of judgment. New conditions enter, occasions for error and bias crowd in, and it is these to which attention is drawn in distinguishing between *simple* and *composite* units.

Moreover, the addition of a limiting word to a simple unit may change the meaning which the root carries when used alone. For instance, the unit "room," in a survey conducted

solely to determine the size of rooms in tenement buildings would be defined in such a way as to call for the listing of any portion of a house habitually used as a place of abode set off by walls with exits either closed or capable of being closed. To add to this unit the word "sleeping," suggests so many considerations respecting light, ventilation, size in respect to number of occupants, and time of occupancy, etc., as materially to alter the meaning attached to the unit when the counting was undertaken to determine size, but not size in connection with use.

The point which it is sought to emphasize is the fact that the identity of a statistical unit is a function of its use. For simple units, identity is established by general criteria; for composite units, by particular criteria. The more complex a unit becomes, the narrower is its application and the greater the necessity that its parts be standardized. Crude units may suffice for general impressions, but standardized measures are necessary for discriminating analysis. This is particularly true in cost accounting. Cost units must be reduced to their simplest and most elementary form. If composite or compound units are used, comparisons are likely to be misleading and their significance indeterminate. This fact is no less true in the use of statistical than in cost data.

2. *Units of Analysis and Synthesis.*

Both simple and composite units become *units of analysis and synthesis* when comparison or the establishment of relations follows from their use. Before classifying and discussing these, brief attention should be given to comparison and to what it implies statistically.

Comparison must be made between things possessing common qualities. These may be of time, of place, or of condition. For instance, the accident rate in a given industry may be compared before and after the installation of safety devices. Comparison may extend to two industries operating at different places or under different conditions, the purpose being merely to record a quantitative difference. But comparison is rarely made for this alone. Generally, a more or less definite purpose of establishing causal connection lies in the back-

ground. A specific inquiry is to determine whether phenomena stand in the relation of cause and effect, or whether they are the result of a common cause.

How nearly economic and business phenomena remain homogeneous for any appreciable period, even in an approximate sense, is always problematical. The forces affecting them are always in a state of flux governed as they are by population composition, state of trade, distribution of wealth, custom, fad, fashion, prejudice, etc. The whole range of human reaction is exhibited in more or less degree. Statistics under such circumstances often reveal a partial story, are not comparable from time to time and from place to place, and taken alone constitute a weak and uncertain base upon which to build a cause-and-effect structure.

Since comparison involves the pairing of things or events which are not identical in all particulars, a study of cause and effect, whether of coincidence or sequence, becomes largely a study of association. Causes never operate under exactly the same circumstances. Oneness of effect is only apparent, variation being evident the moment that the scale of measurement is reduced. Simply to assume the proviso "other things being equal" is not fully to atone for the sins committed in statistical comparisons. The "other things" are rarely if ever equal in actual life. Neither economic nor business phenomena go on indefinitely repeating themselves in one unending round of sameness. To expect that an absolute cause will always result in an absolute effect or that the "other things" will automatically take care of themselves is futile.

If comparison of economic phenomena is difficult, and the assignment of cause and effect rarely if ever absolute, the statistical units of measurements, by means of which comparisons are made, must be standardized according to use. Statistical comparisons involve the use of averages, of coefficients or ratios, in which enumerated or estimated numerators are related to enumerated or estimated denominators. To assign meaning to these without taking the trouble to determine the conditions which produce them or their suitability to the cases in point is as wrong statistically as it is logically to draw a false analogy. To do the first is to ignore the existence of deter-

mining circumstances; to do the latter to ignore their application.

The use of averages and coefficients as means of comparison suggests the formation of a judgment or a conclusion following from a full consideration of detail which they replace. Both represent the culmination of a process of thought and when removed from the steps required for their determination are likely to be assigned new meanings and used for purposes foreign to those for which they were designed. Neither should be regarded as a "secret something which determines events." They are simply statistical abbreviations into which are crystallized relations arrived at by logical processes of thought. Chronologically, they come late in the process of analysis.

Coefficients may be classified from two points of view; first, as *units of interpretation* and second, as *units of presentation.* Respecting the first: three subclasses, or more properly, three aspects may be distinguished, viz., those of condition, of time, and of place. The characteristic features of each subclass and the reasons for differentiating the concept in this manner may best be shown by means of illustrations.

(1) *Units of Interpretation.* By the use of clearly defined simple units of measurements, suppose the exact number of deaths from infantile paralysis, occurring in a given year, have been determined for a given district. The population of the same district has also been correctly enumerated or otherwise determined. The problem is to express the deaths from this cause in the form of a coefficient—to relate them to population. Obviously, the total population is too broad a base, since the particular cause of death is common to only a restricted group of the total. Conditions affecting both numerator and denominator must be made homogeneous. Similarly, industrial accident rates are of little comparative worth unless both frequency and severity are related to a standardized occupational exposure. If cost coefficients, in the business world, are to be significant, comparisons between stock turnovers, for instance, must be made only when classified sales at cost or selling price are related to classified stock reduced to corresponding bases. Likewise, labor turnover becomes a significant coefficient only when a unit of labor displacement is

related to a corresponding unit of labor force. Comparisons may be general only when the conditions upon which they rest have become standardized.

The distinction which is being emphasized is between crude and corrected coefficients. Crude rates are never to be preferred when corrected ones are available. Correction consists in more accurately defining, measuring and enumerating units and in referring phenomena rigidly to the conditions producing them. Where this is not done, the amount of error involved in comparisons is almost never known, and provision for it seldom possible.

Time and place are also factors of importance in the use of coefficients. A comparison of the death rates from malaria for the South and North is of little real value. There is little, if any, significance in a comparison of the number of miles of steam railroads per capita or per one hundred square miles of territory for New Jersey and Nevada. Why? The answer is clear; because the conditions are so widely different; the same phenomena are related to conditions wholly dissimilar or in each case of local application. Similarly, comparisons of the ratios of the number of bank failures to bank liabilities for the period before state and national regulations were inaugurated with the present time; of per capita city expenditures or debt of the 70's or 80's with 1917, are to a large degree without meaning. In the first case, regulation has so changed the conditions under which banking is done that there is little in common between the earlier and later periods; in the second case, the respective domains of public and private initiative differ so radically that a consideration of the amount of expenditure divorced from the benefits accruing from it is without merit.

Too great care can not be taken to make comparisons legitimate. This is particularly true in the case of statistical comparisons, since they are numerical and seemingly exact. A statistical statement is often taken by the unwary and uninitiated, as sufficient proof of its absoluteness and finality, and is made to support predetermined conclusions or premises to which it has no relation. Too much faith is placed in the efficacy of statistics to "prove things." Reasoning from other

angles is too frequently dispensed with—if not utterly ignored —on the part of the uninformed when "statistics" can be utilized, notwithstanding the fact that they may have no application, may be incomplete, unrepresentative, and questionable in origin, and that the problem can not be understood by an appeal to its numerical side. Loose reasoning and hasty judgments are even less defensible when statistics are appealed to to support a contention than when they are ignored, for the reason that they seem to carry a finality and to suggest a nicety of conclusion not generally associated with a less precise method of approach.

(2) *Units of Presentation.* Coefficients may also be regarded from the point of view of *units of presentation.* This thought suggests classification or the art of arranging data into groups according to their common characteristics. "Performed consciously or unconsciously, the act of classification is indispensable to and accompanies every scientific inference. A mind is orderly or slovenly, according as it does or does not habitually and accurately classify the facts with which it comes in contact. The success of an investigation, the worth of a conclusion, are in direct proportion to the fidelity to this principle and the exhaustiveness with which the process is carried out."*

Loose thinking, mistaken emphasis, and the assignment of cause for effect, or vice versa, result from a denial or a violation of this principle. This truth is involved in all that is suggested in the term "standardization," and applies no less to statistical science than it does to business and economic procedure. It is the principle of orderly arrangement, and to violate it is as indefensible when dealing with statistical facts as when formulating, for instance, systems of cost accounts. A cost system which failed to distinguish between overhead and material costs could no more be defended than a statistical summary which grouped together facts of different properties. Combinations must be made on bases that are common, and classification must follow lines that are significant.

It is indispensable, if statistics are to function, to adopt those units of presentation which give facts vitality. Sta-

*Cramer, Frank, The Method of Darwin: A Study in Scientific Method, p. 88.

tistics collected, classified and tabulated without a well-defined purpose are seldom of much value because of the lack of care in their preparation and because of the absence of a controlling purpose in their presentation. Too frequently the unit groups are so broad, purposeless and indefinite that whatever value the facts may have had as collected, is lost by the failure to correlate the method of presentation with the purpose or function which they are to play. Thus we have death rates tabulated by districts so large that correlation of deaths with their respective causes in detail is difficult if not impossible. From an administrative point of view, such statistics are frequently worthless. Similarly, density of population —a common coefficient—becomes meaningless when assigned to so large a population and so diverse conditions as those comprehended in an entire city. Density as a coefficient is significant only where over-crowding is a problem. Again, it is of limited significance to know that the great majority of wage earners in the United States receive less than, say, $1,200 a year. What is necessary to know is the distribution and wages of those below this limit. The wages of a non-homogeneous class expressed as a total or as an average are of little significance in throwing light on such problems as the distribution of wealth, the basis for arbitration of wage disputes, standards for minimum wages, etc. Units for expression are generally too broad; the facts are related to conditions which are not homogeneous. Statistics in this form become more an end than a means to an end, more a goal than a process.

Too great an expense and insufficient time are the stock excuses given for failure to classify and present statistical facts in detail. The validity of these common excuses for inefficiency and statistical sinning is not always easy of determination, but it is clear that it is not money and time which constitute our gravest statistical needs, but coöperation, planning, correlation of activities, and above all an appreciation of the fact that statistics may serve not only as records of past achievement but far more significantly as guides for future activities. They find their chief justification in the manner in which they minister to our positive needs.

IV. CONCLUSION.

Our general conclusions respecting statistical units as standards both in definition and application may be summarized as follows: Units should be clearly and fully defined in the light of the uses which they are to serve, in keeping with the intelligence of those who are to use them, and in such form that overlapping conditions will be readily detected, misunderstanding difficult and employment specific. They should be rigidly referred to the conditions which produce them; should be homogeneous with respect to the purposes for which they are used, and employed with consistency and integrity. After all, in the development and use of statistical units as standards, as in all statistical processes, an appreciation of the meaning of scientific method and a willingness to be guided by its requirements are indispensable. If either is lacking, statistics and statistical methods are without a logical defense.

THE STATISTICAL WORK OF THE WAR TRADE BOARD.*

By W. M. Adriance, *Director, Bureau of Research, War Trade Board.*

As everyone knows, these are days of unexampled activity in all departments of the government at Washington. The tasks incident to the carrying on of the war have resulted in the creation of what are practically new departments, such as "The Council of National Defense," "The Shipping Board," the Fuel and Food Administrations and "The War Trade Board," and have so stimulated the activities of the regular departments that it would be hard to find the bureau or division which has not felt keenly the urge and drive of the new conditions.

All this is true of the various *statistical* bureaus of the government, as well as of those whose functions are administrative. One of the first needs to make itself felt after the outbreak of the war was the need for statistical information. In connection with the draft and the distribution of its quotas came the need for new estimates of population. The informational work of the Council of National Defense, in the shape of a preliminary inquiry into the country's industrial facilities available for war, had its beginnings months before this country actually entered the conflict. With war once declared, new demands arose for the information in the possession of the Federal Trade Commission. Each day has brought its realization of some new task to be performed and the new task has usually carried with it a new demand for statistical information upon which its performance must depend.

It goes almost without saying that the statistical information of which the various departments were already possessed took on a greatly enhanced value and the existing agencies for collecting this information felt the stimulus of this new demand. But with the creation of new departments and bureaus, and the quickened functioning of the old ones, new statistics have been called for and new statistical bureaus have been rapidly

* Paper read at the seventy-ninth Annual Meeting of The American Statistical Association.

springing up to supply them. So far has this gone that it would probably be safe to allege that no one man in Washington knows of the existence even of all the statistical bureaus of the government, and if there *is* such a man today, his information is likely to be out of date tomorrow.

War means, of course, an enormous expansion of the activities of the Department of War and the Department of the Navy. The raising and sending to France of a great army requires elaborate calculations as to what are called "Requirements of the Program." How many pairs of shoes will be required for our soldiers during the year and how will these requirements be distributed over the twelve months? When millions are being dealt with, this becomes a very elaborate and difficult calculation and it must have as its foundation certain assumptions, or, preferably, statistical information, as to how fast shoes have to be replaced under the conditions of modern warfare. Similar calculations have to be made for munitions, guns, explosives, clothing, transportation, food, etc., in an infinite variety of detail. With requirements known, the next query relates to the supply available to meet them. For government purchasing on a relatively small scale it is sufficient to get in touch with manufacturers by some such process as competitive bidding, supplemented perhaps by information as to the commitments of the individual firms, but for modern warfare a different process is necessary. We must know military requirements, both our own and those of our associates in the war. We must also know the civilian requirements, and over against this total we must set stocks on hand and future productive capacity. The latter may be partly judged, of course, by past production. If total supplies are inadequate it may be necessary to give preference to government needs through the process of commandeering and in many cases it may even be necessary to erect new plants to bring *supply* into relation with the abnormal *demand* of war conditions.

But in any event, statistics of stocks and of production are highly important. Speaking generally and allowing for certain recognized exceptions, we may say that at the outbreak of the war production statistics adequate for war purposes did

not exist. The greatest activity has, therefore, been shown in getting them together. Our manufacturers have been bombarded, and are likely to continue to be bombarded, by questionnaires and by other requests for information emanating from various governmental organizations and only too frequently involving duplication of effort and an undue burden upon the people who furnish the information.

The primary function of the War Trade Board is the control of exports and imports. This simple statement, however, covers a wide range of activities and complex multiplicity of duties, calling for statistical data of many different kinds. This control of exports and imports is, of course, intended to be the sort of control which will add to our national efficiency in the conduct of the war. On the side of imports it becomes a question of what commodities produced in other countries are essential for our operations, and what are to be regarded as luxuries and for that or other reasons cut off as unessential. On the side of exports, it is important to see to it that valuable commodities shall not reach the enemy through contiguous neutrals or otherwise, that neutrals shall not receive exports from the United States which are vitally needed here, and that exports shall move to neutral countries where necessary as a means of obtaining imports in return.

In the carrying out of such a program, a great variety of statistical information must be at hand. The export and import figures of the United States, both before the war and for the three years that the war has been going on, afford, of course, absolutely essential information. But this is far from being the whole story. The normal trade and the war trade of other countries also need to be very carefully and analytically studied. This necessity is a matter of common knowledge in the case of the neutrals of Europe, because of the fear that these countries were serving as a channel through which the Allies might actually supply their enemies with the means of making war.

For many months newspaper and magazine discussion of the problem of the northern neutrals has teemed with statistics and pseudo-statistics of their trade activity. In many cases these statistics have been either absolutely incorrect, or, at the

best, extremely misleading. It was alleged, for example, in a periodical of wide circulation, that last year seventy-five million tons of pig iron were shipped from Sweden to Germany. Now the fact is that Sweden sends *iron ore* rather than *pig iron* to Germany. Her total production of iron ore has never exceeded seven or eight million tons and her exports to Germany have never gone above six million tons. The importation of this Swedish ore, which has a very high metal content, has been of enormous value to Germany, but it is a small amount relative to the alleged seventy-five million tons. The same writer states that in the first three months of 1917, Sweden imported from the United States 16,300,000 tons of pig iron. This is at the rate of nearly seventy million tons per year, which quantity actually exceeds our total production.

Such statements can only be explained on the supposition that *pounds* have been confused with *tons*, or a decimal point misplaced, or some similar gross error committed. Other statistics, correct in themselves, lend themselves to misinterpretation. For example, Swedish imports of grain from the United States increased very greatly after the war in Europe began. This has often been interpreted to mean that Germany was getting the grain. The truth was that Sweden's normal imports from Russia and Germany had been cut off and she had turned to America to make up the deficiency. In spite of our large exports of grain to Sweden in 1914 and 1915, it does not seem likely that the grain was going in any great amount to Germany. Sweden has given Germany very valuable economic assistance, but not to any extent through the import of American iron or the re-export of American grain.

American editors should guard themselves with great care against such errors and misinterpretations. Their evil is twofold; they create misapprehension in the minds of our people as to the relation of the neutrals to the war, and they stir up resentment in the countries concerned at such palpable misrepresentation.

The actual relationship of the European neutrals to the countries at war is a matter of very great import, and it has been made the subject of very careful statistical study by the War Trade Board.

These countries are asking the United States for various imports, particularly food. Exactly what we shall determine to let them have, and just what we shall get in return, are things which are yet to be announced, but they are matters which are being worked out by careful statistical investigation.

This study necessarily covers the field of production, consumption, and trade statistics of the countries concerned.

A second large field where the War Trade Board has a difficult task to perform is found in the Latin American countries. These countries need to be considered from two points of view; as sources of supplies vitally needed by the United States, and as consumers with claims upon us for our exported commodities. Certain things from Latin America we must have: prominent on the list being Chilean nitrates, Mexican oil, Cuban sugar, Brazilian manganese, and rubber and copper from various countries. Where exports are necessary as a means of getting these imports or as a means of paying for them, which is much the same thing, the problems of exports and imports are intimately related to each other. In some cases, however, the question of export allowances reduces to simple questions of need in the country concerned as against available surplus in the United States. In estimating the needs of the various countries, their production and trade statistics as well as our own statistics of exports to them and imports from them, have to be carefully studied.

The war, of course, has caused very great dislocations of trade, and these have to be taken account of as far as possible in calculating export allowances. It is not uncommon, these days, for the War Trade Board to receive urgent requests, particularly for food, from countries whose normal sources of supply have been dried up, and in some cases changes in regular trade channels have to be brought about by the control which the United States can exercise over its foreign trade. Such action is likely to be motivated by the necessity of conserving tonnage, as well as by domestic shortages in the United States. If certain countries of Latin America should be required, for example, to look to Argentina instead of to the United States for their supplies of wheat flour, the action will be grounded on considerations of both sorts, and obviously

trade statistics and a study of tonnage and distances are the necessary foundations for a sound policy. Such questions, therefore, fall within the field of inquiry of our bureau.

This rationing of various countries is fraught with great import to the countries concerned, but our right to control our own trade is undisputed, and our decisions are likely to be accepted as dictated by war necessity.

When we come, however, to the question of apportioning export licenses among our own exporters, we have a problem of another sort. Here, too, the spirit of toleration at present exists. Export control is a new task, due to the war. It will take time to work out an equitable system. There is a general realization of this, but there is also a demand that some equitable system shall be worked out as speedily as possible. To be equitable, such a system should probably have a statistical basis of some sort. Plans are now being worked out for the establishment of a statistical control over the apportionment of exports among consignors, but it is a problem which will require a considerable amount of time for its complete solution. Meanwhile, the task is being performed as best it can by methods which will be discarded later on as mere makeshifts.

I have said already that those parts of our government which are charged with the actual making of war are interested in requirements, stocks on hand, and statistics of production. The War Trade Board is interested in these same things from another point of view. It is very much interested indeed in the question of exportable surplus. Now exportable surplus cannot be expressed in terms of a fixed formula. I can show this by an example The Bureau of Research carefully collected production, export and import figures for a certain cereal, the export of which last year was unusually large, and we reached the conclusion that this year's crop was large enough so that we could export as much as last year and still have more left for home consumption than in recent years, and this without allowing for any imports whatever. Imports in recent years have been large. We arrived, in other words, at a figure which we called "the exportable surplus." We then allotted a certain part of this amount to Latin America

and determined the proportion which might go to a particular country. When this figure was presented to the Food Administration for approval, the verdict was rendered that the said country could have none of the said cereal. At first glance this might seem like the abandonment of a statistical basis for the calculation of export allowances. As a matter of fact it was not. Other crops, notably wheat, are short, and the action of the Food Administration meant simply that the other cereal must be more largely consumed than formerly, both by ourselves and by our European associates in the war, as a means of compensation for the shortage of wheat. It was a particular method of calculating the surplus available for export to Latin America, based upon the principle that the exportable surplus of one commodity is a partial function of the supply and demand statistics of another, and, it needs to be added that the policies of the Food Administration are based upon very full statistical information gathered by their own statistical bureau.

It is one of our tasks then to ascertain this rather elusive thing which is called "exportable surplus" and then to apportion the exportable surplus among the countries to which it is to go, and although exportable surplus does not lend itself to any one rigorous definition, yet stocks on hand and production statistics are of the essence of its calculation. Hence the interest of the War Trade Board in these statistics, an interest which overlaps and runs along with that of the War and Navy Departments, the Council of National Defense, and other departments.

The point that I am leading up to is this: the importance of coöperation between the various departments in the collection of statistics of stocks and of production.

The committees on Federal Statistics of the Economic Association, the Sociological Society and the Statistical Association, are, as you know, interested in the general problem of coördination and coöperation in the statistical work of the various departments. Particular aspects of this problem present themselves in the ordinary course of our work, and in a piecemeal fashion beginnings are being made towards its solution. For example; the Geological Survey had before the

war established itself in the field of mineral statistics. Plans have recently been made between the Survey, Doctor Ayres' office (the Division of Statistics of the Council of National Defense), and our own, for the coöperative collection of statistics of non-ferrous metals. Perhaps I should say that Doctor Ayres' office initiated the plan and that we were very kindly included in the arrangement.

A great deal more work of this coöperative sort needs to be done. If there were in existence today a general coördinating statistical commission, such as is contemplated by the committees on Federal Statistics of the three associations, it would be of the very greatest service in the winning of the war. Without such a commission, coöperation, coördination, and the avoidance of duplication in war statistical work are, under the drive and stress of war conditions, very difficult matters to work out.

THE DEVELOPMENT OF MILITARY SANITARY STATISTICS.*

By Walter F. Willcox, *Professor of Economics and Statistics, Cornell University.*

By military sanitary statistics is meant the sanitary statistics of military organizations or armies in time of peace or war. It deals with the statistics of sickness and wounds and of deaths resulting from sickness and wounds. It is thus a subdivision of morbidity and mortality statistics.

The study tries to throw light upon the results from various means of reducing morbidity and mortality. This is its main purpose, but it has also a minor purpose, that of showing how far, under present conditions, it is possible to study the morbidity and mortality among soldiers, an occupational class which is rigidly supervised and closely observed, and thus of showing how far it is now possible to study the morbidity and mortality of other occupational classes less open to careful observation.

Unlike the vital statistics of the civil population, these military statistics have not had a steady and regular development. Advances in this field have usually come fitfully and with long strides during or after important wars which have tested the statistical methods, perhaps thought satisfactory in time of peace, and revealed serious defects or weaknesses. It is even more true of them than of statistics in general that their development has resulted from the initiative and energy of a few individuals who often had to struggle against the inertia or even the active opposition of a rigid, inflexible system.

The nineteenth century has been called "the statistical century." At its threshold what statistical information there was regarding the life of states was treated as a state secret to be carefully kept from the public. Partly for lack of this information public opinion, the vital force and guiding principle of modern nations, was cramped in its development, and the guidance of the state was left in the hands of a small

*Paper read at the seventy-ninth Annual Meeting of The American Statistical Association.

governing group or clique to whom alone these arcana were accessible. By the century's close, even the most autocratic or reactionary governments had begun to publish statistical information and had thereby prepared the soil for a vigorous growth of enlightened public opinion. With even greater truth the nineteenth century has been called "the century of democracy." The two currents of development have not merely run parallel, they have reinforced each other and in a sense are diverse aspects of a single series of changes.

In no field has the transformation been more marked than in that of military statistics. When the United States secured its independence and for a number of years into the nineteenth century, no country in the world possessed trustworthy and detailed information about the health of its military and naval forces. What meager information we have regarding the medical history of the American Revolution is in a few references scattered through the works of Dr. Benjamin Rush, and that regarding the medical history of the war of 1812 is limited to Dr. James Mann's *Medical Sketches*. Soon after the close of the Napoleonic Wars, England began to record the medical experience of her army in reports of the medical transactions in the British army, a series established by Sir James McGrigor, the director general. In this, as in many other lines of statistical activity, the United States echoed speedily but feebly the movement started in the mother country. Quarterly medical reports of the cases of sickness and death in the American army began in 1819, three years after the English series started, and the system has been maintained with some modifications for almost a century. In both countries for years dust gathered on these annual reports, which were well nigh useless as guides to action for protecting the health of American or British soldiers. But with the great popularization of statistical researches on both sides of the Atlantic in the thirties of the last century, these long forgotten reports were disinterred and used. Here again we were followers of England, in which country the initiative was taken by an individual and followed by the government. A. M. Tulloch, then in the recruiting service, interested himself to discover whether a system of discharging every soldier after ten years

of service would not reduce the heavy financial burden of the existing system. To get an answer, he needed to know the death rate in the army and found that a deputy inspector of military hospitals in Edinburgh, named Henry Marshall, had gathered much information on the subject. At the time when Tulloch published his results,* the Secretary of War, Earl Grey, was concerned about the heavy losses among British troops in the West Indies and his attention was drawn to Tulloch's conclusions. So the latter was asked to draw up, first for the secretary of war and later for Parliament, a statement about the mortality in the army prepared from the unpublished reports of the Medical Department and the War Office. Tulloch's first articles appeared in 1835, and three years later, perhaps as a result of his work, returns regarding the health of the British troops in the West Indies after 1817 were published, and in 1839 returns regarding the health of the British troops in the United Kingdom after 1830 first saw the light. The next year saw the first American publication in this field, a study of the sanitary conditions in the American army, 1819–39, the first twenty years of observation.† The author was a member of the United States army and prepared his monograph under the direction of the American surgeon-general.

In this field, as in many other lines of democratic development, Great Britain pointed the way, the United States followed next and on the Continent like changes were made later. Thus in Prussia annual returns began in 1820 and the first interpretation of these manuscript sources was made in 1843 by a private statist, but no official publications appeared until 1860; for the Austro-Hungarian army meager and insignificant data were given out for the years 1844–47; for France the army mortality figures of single scattered years were published as early as 1822, but no reports appeared on a common plan or for consecutive years.

Such was the situation when the Crimean War in Europe, the Civil War in America, and the first of a series of Inter-

**United Service Journal*, XVII: 145–179 (January, 1835), "Observations on Military Pensions," and XVIII: 145–172 (May, 1835), "Mortality among Officers in the British Army."

†Samuel Forry, *Stat. Rep. on the Sickness and Mortality in the Army of the United States*, Washington: 1840.

national Statistical Congresses occurring at intervals through the third quarter of the last century coöperated to stimulate the recording of sickness and death in the armies of the world as the indispensable prerequisite of far-reaching and systematic efforts to safeguard the health of the soldiers. Probably no other period of equal length has seen so much progress in army sanitation as the decade which embraced the Crimean War and the American Civil War.

When the woeful lack of preparation for the wounded and the sick in the Crimea and Constantinople was made known to England, in October, 1854, soon after the battle of the Alma, it so happened by great good fortune that the two persons who could be of most help were intimate friends. One was Sidney Herbert, the secretary of war; the other, Florence Nightingale, who for years had yearned to become a nurse, had prepared herself for that work by study and practice in the best German and French institutions for training nurses and at the time was in charge of a sort of hospital in London. Something of a scandal was resulting from the letters of a responsible newspaper correspondent who described the wretched plight of the sick and wounded in the hospitals across the Bosporus from Constantinople and accused the British medical staff of gross neglect of duty. Secretary Herbert was technically only a financial official, but he went outside his proper field and decided that in the emergency he would break with army traditions and use women as nurses in military hospitals, as they had long been used in civilian hospitals. He wrote to Miss Nightingale, asking, "Would you listen to the request to go and superintend the whole thing?" On the day before he wrote to her, she had written to his wife a letter proposing to take charge of a small group of nurses to be sent to Turkey at private expense. She went and succeeded. The soldiers and the British public worshipped her and many even of the medical officers were won over to her support. The terrible mortality in the hospitals, a mortality of 60 per cent., or 600 per 1,000 cases, from disease alone during the first seven months of the Crimean campaign sank to about 22 per 1,000 cases, or about one twenty-seventh as great. These services and the popularity they brought her gave her the support

she needed to start a movement for improving the sanitary organization of the British army.

It might have been argued by defenders of the existing system that the conditions at Scutari and in the Crimea which had so stirred the British public were incident to war and no reflection on the system. To meet that objection, it was needful to know whether the conditions were continuing, whether the health of the British army at home and in time of peace was good or bad. After Miss Nightingale returned from her war work determined to fight for better treatment of her children, the soldiers, she met Dr. Farr, who pointed out to her the use of mortality figures in studying the healthfulness of various classes of civilians. Following this hint, she compared the death rate of British soldiers in barracks with that of men of corresponding age in the general population. It appeared that the soldiers, although supposed to be selected, healthy men, had twice the mortality of civilians of the same sex and age. This unimpeachable evidence was the strongest point in the argument by which Herbert and Miss Nightingale, working hand in hand, with almost daily consultations, through months of delay, triumphed over indolence and procrastination in high places and quiet but effective opposition among the medical men in the army. First, a Royal Commission was appointed with broad powers and Herbert was made its chairman. No one seemed to think then, as many would now, of making Miss Nightingale a member of the commission, although undeniably she knew more about the subject than any other person. The question of inviting her to appear as a witness was raised, but finally it was decided to ask her to submit written answers to a series of interrogatories. Her efforts to have Dr. Farr made a member were fruitless. The result was that Herbert and Miss Nightingale with help from Sutherland made a little inner circle which guided the commission throughout. Miss Nightingale's work was much like that of a competent commission secretary. As each branch of the inquiry was taken up she handed the chairman a memorandum about it, suggested the witnesses and often interviewed them before they testified. In some cases she prepared the briefs for cross-examination. The most striking feature

of the report was the official promulgation of the figures she had prepared months before, showing that at home and in time of peace the mortality of the army was double that of the men of the same ages in the civil population.

Soldiers were recruited at about nineteen years of age. They came mainly from the ranks of agricultural laborers and town wage earners, were carefully inspected, and the weak ones were rejected. So they should have been especially healthy. Yet the death rate of non-commissioned officers and men per 1,000 mean strength was 33.0, while the death rate of males of the same ages in the general population was 9.2 and in the healthy districts was 7.7. Thus the death rate of soldiers in time of peace was three and one half times that of the male population of like age.

This comparison was open to criticism because a large portion of the army was serving in unhealthy tropical districts. To meet the objection, the returns from soldiers abroad were excluded. It then appeared that the death rate of the army at home in time of peace was 17.5 and that of the male population at army ages was 9.2 for England and 12.4 for Manchester, one of the unhealthiest cities in the realm. In other words, the death rate of soldiers in England in time of peace was 90 per cent. above that of the male population of like ages. But to make such comparisons fair, as the Report pointed out, the army death rate should be raised to allow both for those who did not apply or applied and were rejected because of feeble health and also for those who had served in the army, had been discharged in impaired health due to their service and afterwards died but whose deaths did not appear on the army record. The fairest comparison was thought to be that between the death rate of soldiers and the death rate of agricultural laborers of like ages, who were members of friendly societies and so received help in illness like that the soldier received from the government. A comparison with various occupational groups led to the conclusion that army life in England in time of peace was almost the unhealthiest occupation an Englishman could follow.

After clearly establishing this fact, the next step was to study the causes of the high mortality. Those suggested as

worth studying were: (1) night duty; (2) lack of exercise; (3) bad habits; (4) crowded quarters and bad ventilation and sewerage. The first cause, although much emphasized by army medical men, was probably of little importance. The police had a more burdensome night duty but a death rate only half as great. Lack of exercise was probably more serious. Agricultural laborers were very long-lived and their main advantage lay in the amount and variety of exercise they took in the open air. Cavalrymen had a death rate much lower than that of infantrymen and the main difference in favor of the former was the greater amount of exercise they took in the open air and their heavier work in caring for their horses. The soldier suffers greatly from ennui, does little work, and has little to show for what he has done. Lack of the exercise connected with useful labor was, therefore, probably an important cause of a high death rate. Soldiers were probably not more intemperate than the classes from which they came, and there was little evidence that intemperance was a cause contributing to the high death rate of soldiers. Soldiers probably indulged in sexual excesses to a greater degree than civilians and venereal diseases among them were more widespread and harmful. But more important than any of these probably was the fourth cause of a high mortality, namely, crowded quarters and bad ventilation and sewerage. Pulmonary consumption was far more common and fatal in the army than in civil life.

In civil life insufficient clothing, unwholesome food, a sedentary occupation and vitiated air were causes predisposing to consumption. Only the last of these existed in the army. The only army in which the death rate did not decidedly exceed that of the civil population from which it was drawn was the native army in India. This was the only army not housed in barracks. Each sepoy received a small sum of money with which he housed himself. The minimum space specified for each soldier in barracks was 450 cubic feet (about 7 x 7 x 9) and in most cases this minimum was not provided. The distance between beds was even more important than the cubic space. This should have been but seldom was one foot. No regulation required the commanding officer to

consult his medical officer before locating a camp, or to entrust such an officer with the task of cleaning and preparing a camp or a town to be occupied by large forces. Hence the attention given to medical opinion varied with the character and experience of the commander.

The next battle in the campaign was to secure action from the administration and through it from Parliament. This was even more difficult but was finally secured after a new cabinet had come in with Herbert as the secretary for war. Through long months he had been toiling night and day for the reform, and just as the cause was won his health broke and death took him. The result with Florence Nightingale was not very different; her work in the East during the war and her still more exacting work after her return, when for months, as she wrote in her notes, she stood at the altar of the murdered men, fighting their cause, left her broken in health for life, but glad of soul over the triumph of the reform.

One fundamental feature in the reorganization of the medical division of the British army was the adoption of the recommendations of a Commission on Army Medical Statistics, of which Herbert and Farr were members. Dr. Balfour, who had greatly aided in the reform campaign, was put at the head of the statistical work and his *First Annual Statistical Report on the Health of the Army*, printed in 1861, raised the medical statistics of the British army to the leading position in Europe.

Meantime Austria's war with Sardinia and France had resulted in suffering among the soldiers which appalled both sides. When their conditions were described by the eloquent pen of M. Dunant, a Swiss philanthropist who had gone to their relief, it aroused deep and widespread sympathy which, under the influence of another Swiss, M. Moynier, led to the Geneva Convention and the foundation of the Red Cross. M. Dunant, in a paper read at London, said: "It is to an English woman that all the honor of the Convention of Geneva is due. What inspired me to go to Italy during the war of 1859 was the work of Miss Florence Nightingale in the Crimea."*

When the American Civil War began in 1861, the experiences of the Crimean War and the danger of an equally unnec-

*E. T. Cook, *Life of Florence Nightingale*, II: 205.

essary loss of life were in the minds of many enlightened American citizens. The volunteers were stationed first in state camps and not transferred to the federal government until they had been organized into complete regiments equipped for fighting. During this intervening period the men were undisciplined and developed or retained unsanitary habits. Their officers as a class were ignorant and incompetent, especially in dealing with questions of sanitation.

When these regiments of volunteers began to pour in on Washington in May and June of 1861, their condition was such as to arouse well grounded alarm among patriotic citizens. They "had made their journey in cattle cars as crowded and ill-provided as if they were carrying beasts to the shambles. . . . On arriving no preparations had been made for their reception. Men stood for hours in the broiling sun or drenching rain, waiting in vain for rations and shelter, while their ignorant and inexperienced commissaries and quartermasters were slowly and painfully learning the duties of their positions. At last, utterly worn out and disgusted, they reached their camps where they received rations as unwholesome as distasteful to them and endeavored to recruit their wasted energies while lying upon rotten straw wrapped in a shoddy blanket."*

To help in meeting this situation the United States Sanitary Commission was organized. Its name and the nature of the powers and duties to be given it seem to have been suggested to its originators by the British Sanitary Commission, sent to the East during the Crimean War with plenary powers to reorganize the sanitary conditions of the British army. Soon after the Civil War opened voluntary organizations designed for the relief of the soldiers had sprung up in various parts of the country. New York City took the lead in an effort to combine these organizations, for which purpose a large and representative meeting of women and doctors was held in Cooper Institute May 6, 1861, at which the Women's Central Association of Relief was organized. Its representatives applied first to the Medical Department of the Army in New York, but on meeting with a rebuff turned to the head of the

*C. J. Stillé, *History of the United States Sanitary Commission*, p. 33.

Medical Bureau in Washington to learn what assistance, if any, the army desired from these voluntary organizations. With them went a distinguished representative of the Physicians and Surgeons of the Hospitals of New York and a representative of the Lint and Bandage Association.

The War Department was then looking forward to a war of the dimensions of the Seminole War or the Mexican War and felt quite competent to deal with it unaided by civilians. The delegation was convinced that prevention was far more important and efficient than relief and that the situation demanded the appointment of a commission with full power to establish a preventive hygienic and sanitary service but found themselves quite unable to bring the acting surgeon-general to their point of view. Because of this disagreement they modified their proposal and in a subsequent memorial to the secretary of war proposed the appointment of a mixed commission of civilians, medical men and military officers "who shall consider . . . the prevention of sickness and suffering among the troops and suggest the wisest methods which the people at large can use to manifest their goodwill towards the comfort, security and health of the army."*

After considering this plan, the acting surgeon-general recommended to the secretary of war the appointment of "A Commission of Inquiry and Advice in respect to the Sanitary Interests of the United States Forces." After hesitating to establish what President Lincoln called "a fifth wheel to the coach," the departmental officials finally adopted the recommendation and launched the commission stripped of nearly all the attributes first desired by its advocates. The officials apparently expected it to be useless, but also harmless, and speedily to disappear. That it flourished instead of withering was due mainly to the energy and wisdom of the commissioners and of their secretary, F. L. Olmsted, who played the part of General Manager. From the start the commission carefully and invariably avoided undertaking any duties devolving on a government official but merely proffered him its aid and sought thus to supplement the resources of the government, material or personal.

*C. J. Stillé, *History of the United States Sanitary Commission*, p. 528.

As always in such cases, people contributed more readily and generously for relief than for prevention and more readily for prevention than for the expenses of administration. Indeed the commission might early have failed and certainly would have fallen far short of what it did achieve, had it not been for the generosity of California and the adjacent states. Lying, as they did, removed from the scene of conflict perhaps 5,000 miles by the shortest travelled route, they sent no regiments into the northern army. But they were winning streams of gold from their hillsides, and in the fall of 1862 the mayor of San Francisco telegraphed the President that he held a fund of $100,000 raised in that city for sick and wounded soldiers and asked advice about its disposition. The President consulted the surgeon-general, who advised that it be forwarded to the Sanitary Commission. This advice was adopted and before the close of the war the commission received from the Pacific states $1,500,000, or twice as much as the cash contributions from all the rest of the country. Is it fanciful to see an analogy between the relation of California to our Civil War and the relation of the whole United States to the present war in Europe, between the $100,000 telegraphed from San Francisco to Washington in 1862 and the $100,000,000 raised in a week in this country in 1917 by the American Red Cross largely for the relief of stricken Europe?

The next important step in the development of medical sanitary statistics was due in some measure to the work of Dr. J. S. Billings.

Because of his work on the Index Catalogue of the National Medical Library and as designer of the Johns Hopkins Hospital, Billings, during the last quarter of the nineteenth century, was perhaps more widely known abroad than any other American physician. In 1881 he had been invited to make one of the general addresses before the International Medical Congress at London, this being the first time any American had been so honored. His address on "Our Medical Literature" won the greatest approval. At its close the audience rose and shouted and cheered until they were hoarse, after which the President said, "If this single paper were the sole production of the Congress, it was worth coming here to meet in order that

it might be produced."* Consequently, when Billings was invited, nine years later, to address the section of army surgeons at the Berlin meeting of the same body on the topic, "Can the reports of sickness and deaths in the armies of different nations be made upon an uniform plan in order to obtain comparative statistics of scientific value?" professional expectation was doubtless high. It was not disappointed, for the paper is the ablest analysis I have found of the international aspects of our problem. As a result of the discussion that followed, a special commission was appointed to consider the plans proposed. It advised that an international commission should be appointed to consist of a delegate from the medical department of the army of each coöperating country. To this commission should be referred the task of drafting forms of tables for a uniform international system of military medical statistics. The commission was duly appointed and met, with the United States and ten European countries represented, at Budapest in 1894 in connection with the International Congress on Hygiene and Demography.† It recommended:

1. That an annual report about the army's sanitary condition should be published by each country.

2. That the coöperating countries should exchange these publications.

3. That an annual report, showing the results of the physical examinations of recruits, should be published by each country.

4. That these reports should speak for the calendar year.

5. That the annual report on recruits should include

(a) Number subject to draft who were examined;

(b) Number found available for military service;

(c) Number rejected as too short;

(d) Stature of those accepted in gradations of 5 cm. (about 2 inches);

(e) Defects of those rejected according to a list of defects to be decided by each army.

6. That in computing an army's mean strength only the

*F. H. Garrison, *John Shaw Billings: A Memoir*, pp. 231, 241.

†A copy of this commission's report printed as a manuscript is in the Surgeon General's Library at Washington.

men and subordinate or non-commissioned officers should be included.

7. That in computing an army's mean strength the persons in hospitals should be included.

8. That a classification of the cases of contagious disease into those occurring during the first year of service and those occurring later should be made.

9. That a classification of the sick into those sick in barracks and those sick in hospital should be made.

10. That a classification of the sick who were discharged into those fit for duty, dead and other cases should be made.

11. That the number of days lost through sickness should be shown.

12. That deaths from accident and suicide should be reported separately from deaths from sickness.

13. That the standard ratio used should be per 1,000, but in certain cases ratios per 100,000 might be introduced.

14. That the international tables should show only a few of the most important diseases arranged alphabetically.

15. That in cases of death the length of service should be shown as within one year, more than one year.

16. That the ages of decedents should be shown as 20–25, 26–30, over 30.

By this survey of the development of military sanitary statistics the following conclusions are suggested as probable:

1. The development of military sanitary statistics has proceeded spasmodically in close association with certain great wars and great statists.

2. The care for the health and efficiency of an army, of which its system of sanitary statistics is an important part, when tested by the strain of a great war has usually been found inadequate.

3. The most promising way in which to diminish the danger of such a breakdown or, if it occurs, to keep its evil results within bounds is by invoking or welcoming the coöperation of civilian sanitarians and statists to take part of the strain off the machine.

4. The breakdown of the army sanitary system may arouse a wave of popular criticism strong enough to overcome official

inertia and devotion to precedent, but this criticism is likely to pass away without leading to important constructive results, unless sanitarians and statists of vision and sound judgment are in a position to guide it into wise channels.

The difference is illustrated by the efficiency of Florence Nightingale and Sidney Herbert and the inefficiency of John Shaw Billings in trying to introduce improvements into military sanitary statistics. The latter was quite as able a statist as either or both of the former, but he had no driving force of public opinion and indignation to give strength to his arm. Thus his efforts at reform (even by introducing mechanical methods) had little permanent result.

5. The difficulties in the way of an effort to get comparable figures of sanitary conditions in the various armies and navies of the world are almost insuperable. Can anyone from existing returns rank the armies of the world in the order of their healthfulness in time of peace or even decide whether in this country the army or the navy is in a better sanitary condition?

THE MORTALITY OF CHILDHOOD.*

By Louis I. Dublin, Ph.D., *Statistician, Metropolitan Life Insurance Company, New York*

There are few authoritative papers in American vital statistics on the mortality of childhood. Such as have appeared, moreover, have been limited for the most part to infant mortality. The other divisions of child life, *i.e.*, the pre-school years and the interesting years of school life, have been virtually overlooked. The annual mortality reports of the United States Bureau of the Census contain the crude basic data on deaths at these ages but make no attempt to analyze the figures. The reports of the health departments of a very few states and cities contain references to their child mortality; but these are casual and scattered and have no great scientific value. In spite of the great interest and importance of the subject, there is today no phase of the whole mortality problem in the United States for which we have less definite information. The public health programme for the conservation of child life has undoubtedly been hampered as a result.

In this paper we shall attempt to bring together the facts with regard to child mortality that are available for the Registration Area of the United States and for a large group of insured children in the families of wage earners in the United States and Canada. The figures which we shall present have, to be sure, some limitations which we shall point out as we proceed. Our prime emphasis throughout will be on the practical uses of these data in public health work for children. First we shall consider the mortality of children for all causes of death combined and later, for the chief causes of death in each of the principal age periods of childhood.

MORTALITY OF CHILDREN: ALL CAUSES OF DEATH COMBINED.

There are two outstanding facts with regard to child mortality: childhood is ushered in with the highest mortality rate and closes with the lowest rate of any divisional period

*Paper read at the seventy-ninth Annual Meeting of The American Statistical Association.

of life. There is, accordingly, a very rapid downward sweep in the death rate from age to age throughout childhood. The mortality during childhood should, therefore, be studied by single years of age; at any rate, during the first five years of life where the most marked changes occur from age to age. After the first quinquennium the mortality may readily be studied by five year periods of age. The following table presents the mortality rates for male and female children under age 15. The figures cover the six year period 1910 to 1915 for the expanding Registration Area of the United States. The populations have been estimated by means of the arithmetic annual increment method, using the annual estimates of total population for the Registration Area and distributing the sum by sex and age period on the basis of the distribution found by the 1910 Census.

TABLE I.

ESTIMATED POPULATION,* DEATHS AND DEATH RATES PER 1,000, EXPANDING REGISTRATION AREA OF UNITED STATES, 1910 TO 1915, AGES UNDER 15 YEARS. MALES AND FEMALES COMPARED.

Age Period.	Males.			Females.		
	Estimated Population.	Deaths.	Rate per 1,000.	Estimated Population.	Deaths.	Rate per 1,000.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Under 1	4,079,018	513,338	125.8	3,965,102	400,883	101.1
1	3,635,315	99,319	27.3	3,535,519	88,256	25.0
2	3,987,611	43,682	11.0	3,875,231	39,129	10.1
3	3,940,004	27,156	6.9	3,884,218	24,549	6.3
4	3,894,300	19,732	5.1	3,779,968	17,868	4.7
Total under 5	19,536,248	703,227	36.0	19,040,038	570,685	30.0
5 to 9	17,609,764	58,378	3.3	17,257,519	52,205	3.0
10 to 14	16,870,390	38,653	2.3	16,603,960	35,135	2.1
Total under 15	54,016,402	800,258	14.8	52,901,517	658,025	12.4

* Thanks are due to the Prudential Insurance Company and to the Census Bureau for basic data used in estimating these populations.

Columns 4 and 7 in Table I show the death rates for males and females respectively in the several age periods. The highest mortality occurs, of course, under age one; 125.8 and 101.1 for males and females respectively. These figures must be distinguished from the so-called infant mortality rates which are based on the number of births reported. A

sharp decline is observed in the death rate for the next year of life, between age one and two. The rates are then 27.3 and 25.0 for males and females. The rate of decline during the next three years of life is less marked. At the age period two to three years the rates are 11.0 and 10.1 for males and females and in the next age period, three to four years, the rates reach the comparatively low figures of 6.9 and 6.3 per 1,000 for males and females. At age four to five years the figures are 5.1 and 4.7 per 1,000 for males and females respectively. After age 5, the decline in the death rate is slight for each succeeding individual year. For the entire age period five to nine years the death rate is for both sexes but slightly over 3 per 1,000. For the period 10 to 14 years the rate is not much more than 2 per 1,000 exposed. The minimum during the whole range of life is then attained. It should be noted that the mortality rates for males are uniformly higher than for females throughout the entire period of childhood, although it has been widely observed that the rates for the two sexes converge almost to identity at about age 13. After this point, the rates for the two sexes diverge again, the females showing progressively lower figures of mortality than the males. The general trend of the rates is, however, much the same for each sex.

The rates of mortality in this table apparently are regular in their downward course and in themselves do not suggest any internal technical difficulties. It is a well established fact, however, that the estimated population of the ages of childhood based upon the Census enumerations is far from perfect. The population under 1 year of age is practically always under-enumerated. The enumeration of population at the period one to two years is also too low as is indicated in columns 2 and 5 of Table I by the fact that the number is less than for any succeeding year in the period 1 to 5. Thereafter, the ages 2, 3 and 4 last birthday do not present substantial difficulties for our purposes. The number of persons living declines with each succeeding year of age in practical accordance with the death rate at these ages. We may, therefore, say that the mortality rates presented in columns 4 and 7 are somewhat higher than they should be in

the first two years of life and that thereafter up to age 15 they probably approach closely to the true facts of child mortality in the area covered.

To overcome the difficulties involved in the above table which result from the defective enumeration of children at the youngest ages, we may profitably use the figures in the recently prepared United States Life Tables 1910. In these tables, Prof. J. W. Glover, who supervised the compilations, smoothed or graduated the populations recorded at the several age periods of childhood, following the method employed in the preparation of the German tables for the period 1891 to 1900. As a result of these smoothing processes, he obtained rates which are in all probability a closer approach to the true facts of mortality for the individual years of life in childhood than are the unadjusted figures presented in Table I. We present in Table II the values obtained by Professor Glover. They cover the three calendar years 1909 to 1911 and relate to the original registration states as constituted in 1900. It should be noted that these figures are not central death rates but are based upon the estimated populations at the beginning of each age period.

TABLE II.

DEATH RATES AT SINGLE AGES UNDER FIVE YEARS AND BY FIVE YEAR AGE PERIODS THEREAFTER UP TO AGE FIFTEEN, ORIGINAL REGISTRATION STATES—1909–1911. MALES AND FEMALES COMPARED.

Age Period.	Death Rate per Thousand.	
	Males.	Females.
0–1	125.0	103.8
1–2	28.8	26.4
2–3	13.0	11.6
3–4	8.1	7.6
4–5	5.8	5.5
Total under 5	39.3	33.2
5–10	3.6	3.3
10–15	2.4	2.2
Total under 15	15.7	13.3

A comparison of the rates in Tables I and II confirms the essential facts already brought out with regard to the mortality from all causes combined in the period of childhood. The death rate for males in childhood is at every point higher

than for the females. The rates of decline in mortality from age period to age period are also much alike in both tables. In fact, beginning with age 4 last birthday, the figures for the Registration States 1909 to 1911 and for the Registration Area 1910 to 1915 are very much alike. Such differences as appear in the two tables after age four are probably due to the somewhat different areas covered and to the different years of experience employed. The mortality rate of children has been somewhat on the decline since 1910 and this is shown in the lower rates in the later figures for the Registration Area. Figures prepared by us for the Registration Area for the years 1909, 1910 and 1911 approach the Glover figures much more closely.

TABLE III.

DEATH RATES PER 1,000. EXPANDING REGISTRATION AREA, 1910 to 1915, ORIGINAL REGISTRATION STATES, 1909 to 1911, AND WHITE LIVES, INDUSTRIAL DEPARTMENT, METROPOLITAN LIFE INSURANCE COMPANY, 1911 to 1916 COMPARED. SINGLE YEARS OF AGE UNDER FIVE; FIVE YEAR AGE PERIODS THEREAFTER UP TO AGE FIFTEEN.

Age Period.	Males.			Females.		
	Exp. Reg. Area 1910 to 1915.	Orig. Reg. States 1909 to 1911.	M.L.I. Co. White Ind'l 1911 to 1916.	Exp. Reg. Area 1910 to 1915.	Orig. Reg. States 1909 to 1911.	M.L.I. Co. White Ind'l 1911 to 1916.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Under 1.....	125.8	125.0	—	101.1	103.8	—
1.....	27.3	28.8	—	25.0	26.4	—
2.....	11.0	13.0	—	10.1	11.6	—
3.....	6.9	8.1	8.1	6.3	7.6	7.6
4.....	5.1	5.8	6.0	4.7	5.5	5.5
Total under 5...	36.0	39.3	—	30.0	33.2	—
5 to 9.....	3.3	3.6	3.6	3.0	3.3	3.3
10 to 14.....	2.3	2.4	2.3	2.1	2.2	2.3
Total under 15..	14.8	15.7	—	12.4	13.3	—

A third source of data is available in the mortality figures for the Industrial Department of the Metropolitan Life Insurance Company, which has a large exposure of children. Unfortunately, the actuarial* necessities of the case make a

*The insurance experience contains no children under one year of age. This experience is also compiled on the "Calendar year basis," that is, the age of the lives exposed is automatically advanced one year on each January 1 irrespective of the actual age of the insured at that time. This actuarial process results in advancing the ages of the young children so appreciably that the rates obtained for ages 1 and 2 last birthday are not comparable with population rates. Beginning with age 3 last birthday and thereafter the processes of the calendar year method balance each other at the beginning and at the end of each year of age and the rates obtained are, as a result, comparable with population figures for the same ages

comparison of the data impossible for the ages one and two last birthday. Thereafter, that is, beginning with age 3, the rates are, as is seen in columns 4 and 7 of Table III, consistent with those previously presented in Tables I and II and indicate that the insurance experience for the children of the wage earners of America approximates fairly well the mortality of children in the general population. Limitation is made in these insurance figures to white lives and the period covered is for the six years 1911 to 1916. The experience includes nearly all the states of the United States and the Provinces of Canada.

PRINCIPAL CAUSES OF DEATH IN CHILDHOOD.

Certain diseases and conditions are preëminently those of childhood. The causes peculiar to early infancy, the acute infectious diseases such as measles, scarlet fever, whooping cough and diphtheria, and the nutritional diseases such as infantile diarrhea and enteritis, are encountered almost entirely in children under 15 and have a negligible incidence beyond that age. On the other hand, conditions such as tuberculosis, all forms of pneumonia, and certain traumatisms, while more or less prevalent in childhood are found appreciably in other periods of life. Interest centers in the diseases of childhood because they have proved a very fruitful field of research for the medical investigator even if much promising work still remains to be carried out. A consideration of the causes of death in childhood is, moreover, indispensable from the standpoint of public health service and the prevention of disease generally. We shall in the following discussion consider the several important causes of death in each one of the age periods, both as to relative importance and as to the actual rates of mortality incidence. For this purpose we shall use as our basic material the returns for the expanding Registration Area for the 6-year period from 1910 to 1915 and the data of the Industrial Department, Metropolitan Life Insurance Company, from 1911 to 1916. It is encouraging in connection with this proposed discussion that we are concerned with deaths that are, for the most part, well reported and fairly reliably stated as to cause.

THE FIRST YEAR OF LIFE.

In the first year of life, a very few diseases and conditions account for the larger part of the mortality. Thus, the group of conditions included under the terms congenital debility and malformations and the injuries at birth together account for 37.6 per cent. of the total. Next in importance we find diarrhea and enteritis with 24.4 per cent. of the total deaths. The respiratory diseases which are for the most part bronchopneumonia, but which literally include lobar and undefined pneumonia as well as bronchitis, are together responsible for 15.5 per cent. of the deaths. We see, therefore, that three groups of causes alone account for nearly four-fifths of the total mortality of the first year of life (77.5 per cent.).

The remainder of the mortality is distributed over a considerable number of conditions no one of which is of preëminent importance. The four important communicable diseases of childhood, which we shall find very prominent in our discussion at the other age periods, are not represented to any large degree in the first year of life, with perhaps the exception of whooping cough which accounts for 2.3 per cent. of the total deaths. The highest rate for whooping cough at any age is found in the initial year of life. In fact, over one-half of all the deaths from this disease are located in this first age group. A large proportion of the deaths from measles are also found in this first year of life. The relative significance of measles to all causes is not as great, however, as we shall find it in the later periods. Tuberculosis looms larger in this age period than any of the acute infectious diseases named, except whooping cough. About one-half of the tuberculosis deaths are from tuberculous meningitis. Finally, syphilis, which is undoubtedly under-registered at present, is noted in 1.2 per cent. of the total deaths. In view of the high total mortality, we find the rate for this condition extraordinarily high, 137.6 per 100,000; higher in fact than is found at any other age period in life. Other diseases such as meningitis, convulsions, "other diseases of the stomach" and the "ill-defined diseases" are so unreliable in their certification that it is not desirable to refer to them in any fulness. As regis-

tration improves, they will be found more and more under the more definite titles referred to above. At present, however, they account for an appreciable part of the infant mortality.

The following table presents the important conditions in the first year of life, giving the percentage of each cause to all causes as well as the rate per 100,000 exposed at the age period. It was not thought necessary to give any detailed analysis of the figures by sex because the conditions affect the two sexes very similarly. Noteworthy sex differences appear only for whooping cough which is more prevalent as a cause of death among females, and for the causes peculiar to early infancy, such as injuries at birth, which are much more frequent as causes of death of male babies. This fact is in agreement with what is well known in obstetrical practice, namely, that the larger male baby is more subject to injury than the smaller female child.

Since no insurances are written by the Metropolitan on the lives of children under one year of age no comparative insurance mortality data can be quoted for the first year of life.

TABLE IV.

CAUSES OF DEATH IN FIRST YEAR OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910–1915.

Cause of Death.	Per cent. Total Deaths.	Rate per 100,000.
All causes	100.0	11365.1
Whooping cough	2.3	257.2
Tuberculosis—all forms	1.6	183.8
Tuberculosis of the lungs	.6	66.4
Tuberculous meningitis	.8	84.7
Syphilis	1.2	137.6
Bronchitis	2.5	280.1
Bronchopneumonia	8.1	919.1
Pneumonia—lobar and undefined	4.9	551.4
Diarrhea and enteritis	24.4	2768.6
Congenital malformations—total	5.6	637.5
Hydrocephalus	.4	43.3
Congenital malformations of the heart	3.5	392.2
Other congenital malformations	1.8	202.0
Congenital debility, icterus and sclerema—total	25.9	2946.3
Premature birth	16.8	1909.6
Congenital debility, "atrophy," marasmus	9.1	1036.7
Other causes peculiar to early infancy—total	6.1	696.0
Injuries at birth	3.3	370.1
Other causes peculiar to early infancy	2.7	301.0

THE SECOND YEAR OF LIFE.

The causes responsible for the mortality during the second year of life present a somewhat different picture from that found in the earlier year. The conditions associated with prematurity and with the congenital defects are no longer present to any degree. On the other hand, diarrhea and enteritis continue to play a most important part in the total mortality and are, in fact, the first causes of all in the second year of life; over one quarter of the deaths (27.3 per cent.) are due to this single condition. Next in importance are the respiratory diseases which include bronchopneumonia, pneumonia lobar and undefined and bronchitis. They were responsible for 26.4 per cent. of the deaths in the second year of life. Bronchopneumonia still accounts for the most part of these deaths. The four epidemic diseases, measles, scarlet fever, whooping cough and diphtheria now play a much more prominent part in the total mortality. Together, they account for 17.8 per cent. of all the deaths. Diphtheria is the most important of the four and reaches its highest death rate in any year of life. It is followed by measles with nearly the same rate and by whooping cough and scarlet fever in the order named. Tuberculosis rises in this year into a more prominent position, relatively, than in the first year of life but the actual rate per 100,000 exposed, is somewhat lower. Tuberculous meningitis forms over one-half of the total tuberculosis mortality. Finally, we must take the accidents into consideration, in this second year of life; burns alone now are responsible for 1.7 per cent. of the deaths with a rate of 44.1 per 100,000 exposed and, as we shall see, this condition as well as other accidental causes becomes more and more prominent with the advancing ages of childhood.

Males showed higher mortality rates than females in the second year of life for measles (154 and 142, respectively, per 100,000), scarlet fever (47 and 41 per 100,000), diphtheria and croup (164 and 138 per 100,000), tuberculosis, all forms (156 and 141 per 100,000), tuberculous meningitis (83 and 78 per 100,000), bronchopneumonia (393 and 358 per 100,000), pneumonia, lobar and undefined (266 and 232 per 100,000)

and diarrhea and enteritis (747 and 678 per 100,000). Whooping cough showed a higher female rate (138 per 100,000). The male rate was 105 per 100,000.

As before, there is an appreciable mortality registered for conditions such as dysentery, meningitis, "other diseases of the stomach" and "ill-defined diseases," which are reported so unreliably that no reference is made to them in our Table V which follows:

TABLE V.

CAUSES OF DEATH IN SECOND YEAR OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910-1915.

Cause of Death.	Per Cent. Total Deaths.	Rate per 100,000.
All causes	100.0	2615.8
Measles	5.7	148.1
Scarlet fever	1.7	43.9
Whooping cough	4.6	120.9
Diphtheria and croup	5.8	151.0
Tuberculosis—all forms	5.7	148.2
Tuberculosis of the lungs	1.8	47.1
Tuberculous meningitis	3.1	80.7
Bronchitis	2.5	65.3
Bronchopneumonia	14.4	375.9
Pneumonia—lobar and undefined	9.5	249.1
Diarrhea and enteritis	27.3	713.2
Burns	1.7	44.1

THE THIRD YEAR OF LIFE.

The facts of this age period show a further shift in the relative importance of the several causes of death. The four chief epidemic diseases are now of the first importance, being responsible together for more than one fourth of the deaths (26.4 per cent.). Diphtheria is by far the most prominent of the four and its rate is not much less than for the second year of life when the mortality from all causes was more than twice as great. Scarlet fever while now relatively more prominent has much the same rate as in the preceding year; but the rates for measles and whooping cough have dropped to a little more than one third what they were in the second year. The respiratory conditions including the same diseases listed in the previous discussion, are now responsible for 22.0 per cent. of the total mortality. Bronchopneumonia is still the chief item in this list. Diarrhea and enteritis have de-

clined perceptibly in their proportionate incidence and even more so in the rate, although their importance is not yet to be discounted. The proportionate incidence of tuberculosis has increased also, although the rate per 100,000 has decreased to about one half of the previous one. Tuberculous meningitis is again the prominent form of tuberculosis in this year of life. Accidents and injuries, as might be expected, play an increasingly important part. It is at this age that children begin to manifest extraordinary curiosity about the affairs of the household and their environment generally and indulge in all the activities of the runabout-child. Burns are the most important of the accidental causes of death, being responsible for 4.3 per cent. of the deaths. The rate is practically the same as in the preceding year. We also observe that falls begin at this age period to become an important cause of mortality among children. Attention should also be directed to the beginning importance of typhoid fever, which now is responsible for 1 per cent. of the deaths with a rate of 10.3 per 100,000 exposed.

Measles shows only a slightly higher death rate for males than for females as does also scarlet fever, tuberculosis, all forms, tuberculous meningitis, and bronchopneumonia. Diphtheria mortality is considerably higher for males (136 per 100,000) than for females (122 per 100,000). Pneumonia, lobar and undefined shows a male rate of 98 which may be compared with a female rate of 89 per 100,000. Diarrhea and enteritis shows rates of 143 and 130 per 100,000 for males and females respectively in the third year of life. Burns show a male mortality rate of 49 and a female rate of 40 per 100,000. Traumatism by fall shows, comparatively, a rate of 11 for males and 7 per 100,000 for females.

Several conditions such as dysentery, meningitis, acute nephritis, acute poisonings and ill-defined diseases are registered in significant proportions but their rates, in view of the declining total mortality, are not large enough to warrant any extended treatment, especially in view of the indefinite character of most of these titles or of their unreliability as statements of cause of death. The chief facts for the third year of life are shown in Table VI.

TABLE VI.

CAUSES OF DEATH IN THIRD YEAR OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING [REGISTRATION AREA OF THE UNITED STATES 1910-1915.

Cause of Death.	Per cent. Total Deaths.	Rate per 100,000.
All causes	100.0	1053.2
Typhoid fever	1.0	10.3
Measles	5.5	58.3
Scarlet fever	4.7	49.7
Whooping cough	4.0	42.5
Diphtheria and croup	12.2	128.8
Tuberculosis—all forms	7.2	75.5
Tuberculosis of the lungs	2.2	22.8
Tuberculous meningitis	3.9	40.9
Bronchitis	2.0	20.6
Bronchopneumonia	11.1	116.9
Pneumonia—lobar and undefined	8.9	93.4
Diarrhea and enteritis	13.0	136.8
Burns	4.3	44.8
Traumatism by fall	.9	9.2

THE FOURTH YEAR OF LIFE.

The fourth year of life witnesses another marked reduction in the total mortality rate from the figure of the preceding year. From this age onward the reduction in the mortality from all causes is comparatively slight. The four epidemic diseases together are now responsible for about one third of the total mortality. The chief of these four is diphtheria which accounts for over a sixth of the deaths in both the population and insurance experiences. The respiratory diseases and conditions are of less importance in the fourth year of life than in the preceding age, both in relation to all causes of death and to the exposure. They constitute the second important group with 16.8 per cent. of the deaths among children in the general population and 18.1 per cent. among insured children. In both experiences, respiratory diseases and conditions combined have approximately the same number of deaths as the single cause of death, diphtheria. Bronchopneumonia is still the most commonly reported form of respiratory disease, although lobar pneumonia shows an increasing ratio of importance in the mortality from these conditions. Tuberculosis, all forms, has a slightly higher relative incidence than in the earlier year; the rate is one third lower, however. Tuberculous

meningitis is still the important form of this disease, in both the population and insurance experiences.

Diarrhea and enteritis, a group of diseases and conditions which constitute the fourth cause as to prominence among all deaths in the fourth year of life, are now much less significant than in the preceding ages. They are recorded in 7.3 per cent. of the deaths among population children with a rate of 48.4 per 100,000, and in 8.0 per cent. of the deaths of insured children at a rate of 62.7 per 100,000 exposed. Accidents and injuries show an increase in the proportion of all deaths, but with only a slight decrease in the rate per 100,000 of population. Burns are by far the most prominent accidental cause of death. Traumatism by fall is recorded in about 1 per cent. of the deaths. Vehicular accidents, of which automobile accidents are a prominent element, assume prominence in this age with 1.6 per cent. of the total deaths in both the population and insurance experience.

Typhoid fever shows a similar rate of mortality in this age as in the preceding one, although its relative importance is somewhat increased.

In making these comparisons between the mortality of children in the general population and in the insurance experience, it must be borne in mind continually that the population embraces a considerable rural area while insured children live for the most part in large cities, where the factors of congestion of population affect the incidence and fatality of certain of the epidemic diseases. Traffic conditions likewise tend to increase the mortality rate from accidents of city children.

The mortality rates of the two sexes deserve passing comment. Measles, scarlet fever, tuberculosis and bronchopneumonia show no very significant differences in the mortality rates of males and females in the fourth year of life. Diphtheria, however, continues to show a considerably higher rate for males, 120 per 100,000, than for females, 105 per 100,000. Pneumonia, lobar and undefined was indicated at a rate of 54 per 100,000 for males and only 47 per 100,000 for females. Diarrhea and enteritis had a rate of 52 for males and 45 for females. Traumatism by fall showed a higher rate for males, 8 per 100,000, than for females, 5 per 100,000, as did also

automobile accidents and injuries where the male rate was 4 per 100,000 and the female rate was only 2 per 100,000.

The ill-defined causes of death and a number of others which are in effect terminal conditions of the acute infections are present in this age group as before, but find no proper place in our Table VII which follows:

TABLE VII.

CAUSES OF DEATH IN FOURTH YEAR OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910–1915, AND METROPOLITAN LIFE INSURANCE CO., INDUSTRIAL DEPARTMENT, WHITE LIVES, 1911 TO 1916.

Cause of Death.	Per cent. Total Deaths.		Rate per 100,000.	
	Reg. Area.	M.L.I. Co.	Reg. Area.	M.L.I. Co.
All causes	100.0	100.0	660.8	788.8
Typhoid fever	1.5	1.4	10.2	11.1
Measles	4.4	5.7	29.1	45.3
Scarlet fever	7.0	5.8	46.1	46.1
Whooping cough	3.2	3.5	21.1	27.9
Diphtheria and croup	17.0	18.1	112.2	147.2
Tuberculosis—all forms	7.7	7.2	50.5	56.9
Tuberculosis of the lungs	2.3	1.7	15.3	13.0
Tuberculous meningitis	4.0	4.4	26.7	34.7
Bronchitis	1.4	1.7	8.9	13.2
Bronchopneumonia	7.8	9.3	51.4	73.0
Pneumonia—lobar and undefined	7.6	7.1	50.5	56.1
Diarrhea and enteritis	7.3	8.0	48.4	62.7
Burns	5.9	5.0	38.8	39.4
Traumatism by fall	1.0	1.1	6.8	8.4
Total vehicular accidents	1.6	1.6	10.5	12.9

THE FIFTH YEAR OF LIFE.

In the last of the first five years of life, the total mortality rate has again declined from that of the preceding year. The changes of the relative importance of the individual conditions are also few and unimportant both in the insurance and general population experiences. In fact much the same picture is presented by Table VIII as in the preceding one; our discussion of this age is, therefore, necessarily brief. Attention need be directed only to the increasing prominence of typhoid fever, to the appearance for the first time of appendicitis as a condition deserving comment, and to the presence of the organic heart diseases which are the cause of 1.6 per cent. of all the deaths in the fifth year of life among population

children, and for 1.2 per cent. among deaths of insured children. It is possible, of course, that the latter diseases as well as acute nephritis which we have not included in our table but which is also reported in 1.3 per cent. of the deaths of population children, are in large measure the sequelae of the epidemic diseases. Reference should also be made to the increasing incidence of the vehicular accidents which are in this age period responsible for 2.5 per cent. of the total mortality in both experiences. The automobile accidents are by far the most prominent of the individual conditions under this head.

Apart from a few conditions, there are no very significant differences between the population and insurance experiences among children in this year of life.

TABLE VIII.

CAUSES OF DEATH IN FIFTH YEAR OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910–1915, AND METROPOLITAN LIFE INSURANCE CO., INDUSTRIAL DEPARTMENT, WHITE LIVES, 1911 TO 1916.

Cause of Death.	Per cent. Total Deaths.		Rate per 100,000.	
	Reg. Area.	M.L.I. Co.	Reg. Area.	M.L.I. Co.
All causes	100.0	100.0	489.9	576.0
Typhoid fever	2.2	2.0	10.6	11.5
Measles	3.5	4.5	17.1	25.6
Scarlet fever	7.6	7.4	37.3	42.8
Whooping cough	2.4	2.5	11.5	14.4
Diphtheria and croup	18.8	22.2	92.3	128.0
Tuberculosis—all forms	7.7	7.0	37.6	40.4
Tuberculosis of the lungs	2.5	1.7	12.3	9.6
Tuberculous meningitis	3.8	4.1	18.4	23.4
Organic diseases of the heart	1.6	1.2	7.8	6.6
Bronchitis	1.1	1.2	5.2	7.0
Bronchopneumonia	6.0	6.4	29.2	36.6
Pneumonia—lobar and undefined	6.8	6.3	33.5	36.2
Diarrhea and enteritis	5.0	5.3	24.5	30.6
Appendicitis	1.4	1.0	7.0	5.5
Burns	5.7	5.5	28.1	31.6
Traumatism by fall	1.1	.9	5.2	5.1
Total vehicular accidents	2.5	2.5	12.3	14.2
Automobile accidents and injuries	.8	.9	3.8	5.3

THE SECOND QUINQUENNIUM OF LIFE—AGES 5 TO 9 YEARS.

The second five years of life are characterized by extremely low mortality rates in both experiences of population and insured children. The interrelations between the several causes of death are in the main different from those we have previously described. We are now concerned with a very much larger list of diseases and conditions, a considerable number of which have made their appearance for the first time in any appreciable degree. These include certain organic conditions which are indicative of degenerative processes. Of the epidemic diseases of childhood only two now merit attention, scarlet fever and diphtheria. Measles and whooping cough play comparatively minor parts in the total mortality between ages 5 and 9. Typhoid fever has increased to a respectable figure, 3.7 per cent. of all deaths and a rate of 11.0 per 100,000 for general population children, and 2.9 per cent. and a rate of 10.0 per 100,000 for insured children. Tuberculosis becomes a little more important as a factor of mortality in this period and from now on will be found to increase continuously in its rate for a long period of years. Tuberculous meningitis for the first time in childhood becomes a less important form of this disease than pulmonary tuberculosis. Pneumonia, all forms, is still among the more prominent causes of death; and bronchopneumonia has fallen much below lobar pneumonia in its incidence. Appendicitis has approximately the same mortality rate as typhoid fever in both general population and insurance experiences. The accidents and injuries are prominent and such conditions as falls, accidental drowning and the vehicular accidents, chief of which are the automobile accidents, demand more and more of our attention.

Concerning the organic conditions referred to above, we must direct especial attention to acute articular rheumatism, diabetes, acute endocarditis, organic diseases of the heart and acute nephritis and Bright's disease. Some of these are undoubtedly idiopathic but most of them, probably, are either the immediate or ultimate sequelae of the epidemic diseases of childhood.

TABLE IX.

CAUSES OF DEATH IN SECOND QUINQUENNIUM OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910-1915, AND METROPOLITAN LIFE INSURANCE CO., INDUSTRIAL DEPARTMENT, WHITE LIVES, 1911 TO 1916.

Cause of Death.	Per cent. Total Deaths.		Rate per 100,000.	
	Reg. Area.	M.L.I. Co.	Reg. Area.	M.L.I. Co.
All causes	100.0	100.0	317.2	348.7
Typhoid fever	3.7	2.9	11.6	10.0
Measles	2.5	3.1	7.8	10.9
Scarlet fever	7.1	6.8	22.5	23.8
Whooping cough	1.2	1.1	3.9	3.9
Diphtheria and croup	15.8	19.8	50.2	69.1
Tuberculosis—all forms	8.7	8.0	27.7	27.8
Tuberculosis of the lungs	3.5	2.7	11.2	9.4
Tuberculous meningitis	3.4	3.7	10.7	12.7
Acute articular rheumatism	2.0	2.3	6.4	8.0
Diabetes	.9	.5	3.0	1.7
Acute endocarditis	1.3	1.2	4.3	4.2
Organic diseases of the heart	4.4	4.8	14.0	16.6
Bronchitis	.7	.7	2.2	2.5
Bronchopneumonia	3.5	3.5	11.1	12.2
Pneumonia—lobar and undefined	5.9	5.1	18.7	17.7
Diarrhea and enteritis	2.5	2.4	8.0	8.3
Appendicitis	3.5	2.9	11.2	10.2
Acute nephritis	1.4	.9	4.3	3.2
Bright's disease	1.3	1.2	4.3	4.2
Burns	2.7	2.7	8.6	9.6
Accidental drowning	2.6	3.0	8.3	10.6
Traumatism by fall	1.3	1.2	4.1	4.2
Total vehicular accidents	4.4	5.0	13.9	17.5
Automobile accidents and injuries	1.8	2.5	5.6	8.8

THE THIRD QUINQUENNIUM OF LIFE—AGES 10 TO 14 YEARS.

This age group is characterized by the lowest mortality rate of any divisional period of life. In fact, for all causes of death combined the rate, 2.2 per 100,000 in both the population and insurance experience is less than the rate for some individual diseases in some age quinquennia. The few deaths which do occur in this closing age period of childhood are distributed over a large number of single conditions or causes of death, not any one of which is of great numerical importance. Tuberculosis is the chief cause of death in this divisional period of life, being responsible for 14.8 per cent. of all deaths in the population experience and for 12.8 per cent. in the insurance experience. The death rate for tuberculosis was 32.7 per 100,000 for children in the general population and 28.6 for insured children at this age period. Of these tuber-

culosis deaths, two thirds are of the pulmonary type. Abdominal tuberculosis appears for the first time as a significant cause of death, and requires notice as does also tuberculous meningitis. Typhoid fever has a higher rate than in the preceding age group, but shows a lower mortality rate among insured than among the population children. Appendicitis, likewise, shows an increased prominence in both series in this quinquennium.

Measles and whooping cough are no longer of any great consequence as causes of death in this age period. Scarlet fever and diphtheria give significant mortality figures for the last time. Between 10 and 15 years of age scarlet fever accounts for 3 per cent. of the deaths in both experiences and diphtheria for approximately 6 per cent. of the deaths. The respiratory diseases and conditions show satisfactory declines from the rates in earlier age periods. In this age period pneumonia mortality shows its lowest rate of incidence in any age period of life.

The acute infections, generally, are now replaced in significance by such grave diseases as organic diseases of the heart, acute articular rheumatism, diabetes and acute endocarditis. Organic diseases of the heart are responsible for 12.0 per cent. of the deaths among insured children and for 8.6 per cent. of the deaths among population children of this age group. Acute articular rheumatism showed a ratio of 3.0 per cent. of all deaths for population children and 3.4 per cent. for insured children. Diabetes showed a higher percentage and death rate among children in the general population.

Nephritis and Bright's disease together accounted for 3.5 per cent. of all the deaths among population children and for 2.9 per cent. among insured children.

Accidents and injuries as a group occupied a prominent position in the total mortality, and the vehicular accidents as well as accidental drowning and traumatism by firearms are especially important as causes of death ascribed to this third quinquennium.

Considered by sex, we find that males have a slightly higher mortality from measles, from scarlet fever, bronchopneumonia, and pneumonia, lobar and undefined. For traumatism by fall

males show a rate of 4.8 per 100,000 which may be compared with a figure of 1.3 for females in the general population. Automobile accidents and injuries had a rate of 5.5 per 100,000 for males and 1.0 per 100,000 for females in the third quinquennium of life.

The facts available for this age group in both the population and insurance experience are shown in the following Table X.

TABLE X.

CAUSES OF DEATH IN THIRD QUINQUENNIUM OF LIFE. PERCENTAGE OF TOTAL DEATHS AND RATES PER 100,000, EXPANDING REGISTRATION AREA OF THE UNITED STATES 1910–1915, AND METROPOLITAN LIFE INSURANCE CO., INDUSTRIAL DEPARTMENT, WHITE LIVES, 1911 TO 1916.

Cause of Death.	Per cent. Total Deaths.		Rate per 100,000.	
	Reg. Area.	M.L.I. Co.	Reg. Area.	M.L.I. Co.
All causes	100.0	100.0	220.4	224.0
Typhoid fever	6.4	5.8	14.2	12.9
Measles	1.0	.7	2.2	1.6
Scarlet fever	3.0	3.0	6.6	6.7
Whooping cough	.2	.1	.5	.3
Diphtheria and croup	5.6	6.4	12.2	14.2
Tuberculosis—all forms	14.8	12.8	32.7	28.6
Tuberculosis of the lungs	10.2	8.5	22.4	19.0
Tuberculous meningitis	2.2	2.1	4.7	4.7
Abdominal tuberculosis	1.0	.8	2.2	1.7
Acute articular rheumatism	3.0	3.4	6.5	7.7
Diabetes	2.2	1.6	4.9	3.6
Acute endocarditis	1.8	1.9	3.1	4.2
Organic diseases of the heart	8.6	12.0	18.9	27.0
Bronchitis	.3	.3	.7	.6
Bronchopneumonia	1.4	1.3	3.2	2.9
Pneumonia—lobar and undefined	5.3	4.5	11.7	10.1
Diarrhea and enteritis	.9	.9	2.1	2.1
Appendicitis	6.3	6.3	13.8	14.1
Acute nephritis	1.2	.8	2.7	1.8
Bright's disease	2.3	2.1	5.0	4.7
Burns	1.0	1.1	2.2	2.4
Accidental drowning	4.4	6.0	9.7	13.4
Traumatism by firearms	1.9	1.3	4.1	2.9
Traumatism by fall	1.4	1.3	3.1	3.0
Total vehicular accidents	4.4	5.3	9.6	11.9

SUMMARY OF MORTALITY OF CHILDHOOD.

We have presented in some detail the main facts of mortality in each of the age classes of childhood. We may now summarize our discussion for the entire period, considering primarily the characteristics of the principal groups of causes of death affecting children.

We may conveniently group these causes of death under six heads as follows:

i. Causes indicative of prematurity, of congenital debility or of injury at birth.

ii. Diseases and conditions of the digestive tract.

iii. Diseases and conditions of the respiratory system.

iv. The principal epidemic diseases of childhood: measles, scarlet fever, whooping cough and diphtheria.

v. Accidents and injuries.

vi. Important infectious and organic diseases of miscellaneous order.

I. CAUSES INDICATIVE OF PREMATURITY, OF CONGENITAL DEBILITY OR OF INJURY AT BIRTH.

These causes of death affect, primarily, the first year of life when they are responsible for more than three eighths of the mortality. Only congenital malformations appear to any extent among the deaths after the first year. Yet so great is their importance numerically during infancy that close to a quarter of all the deaths under age fifteen are found registered under these titles.

These causes, for the most part, reflect the influence of prenatal conditions on the child. The health of the mother, her habits and the character of her employment during pregnancy play a large part in this phase of infant mortality. Parental alcoholism and syphilis are perhaps the most potent single factors, although unskilled obstetrical care is still to be considered important.

Male infants show uniformly a higher incidence from these conditions.

II. DISEASES AND CONDITIONS OF THE DIGESTIVE TRACT.

It is advisable to consider only the diarrheal diseases of children, although a number of other, but numerically insignificant, conditions could properly be included under this head. The diarrheal diseases account for a little more than 20 per cent. of the total mortality of children under 15 years of age. They are of great importance throughout the entire range of childhood but the highest mortality is found in the first year of life. In the second year of life the rate is reduced to about one-quarter of what it was in the first year although

it is the first of all causes in its relative importance at this age. For each age thereafter, there is a progressive decline up to and including the age period 10 to 14 years, when the minimum death rate for childhood is reached. Throughout the years of childhood, the male death rate from diarrheal diseases is higher than the female death rate, the excess of male over female mortality being more pronounced at the very early years of childhood.

III. DISEASES AND CONDITIONS OF THE RESPIRATORY SYSTEM.

This group includes bronchopneumonia, pneumonia—lobar and undefined, and bronchitis. Together, these diseases account for 16.4 per cent. of all the deaths in the ages of childhood. Bronchopneumonia is by far the most important of these causes of death with 8.3 per cent. of the total mortality followed by pneumonia—lobar and undefined with 5.9 per cent. and by bronchitis with 2.1 per cent. of all the deaths. The highest death rate for the diseases of the respiratory system is recorded in infancy. The mortality declines with each succeeding age period until the minimum is found in the years 10 to 14. Significant differences in the mortality of the two sexes appear only for the first 4 or 5 years of life. For the ages of childhood after 5 years, the sex differences are not very significant.

IV. THE PRINCIPAL EPIDEMIC DISEASES OF CHILDHOOD: MEASLES, SCARLET FEVER, WHOOPING COUGH AND DIPHTHERIA.

These four conditions account for 10.7 per cent. of all the deaths recorded in our study of this 15 year period of life. Diphtheria is the most important of the four followed by whooping cough, measles and scarlet fever in the order named. These diseases vary somewhat in their points of maximum incidence. The highest mortality from whooping cough is found in infancy. Measles and diphtheria show their highest mortality rates in the second year of life and scarlet fever in the third year of life, that is, between 2 and 3 years of age. After their points of maximum incidence, these diseases decline, although not at the same rate, to a minimum point in the age period 10 to 14 years. Scarlet fever has a mortality

rate in the second, third and fourth years of life which varies but little from the maximum point of 49.7 per 100,000 in the third year of life. The other three of these chief epidemic diseases of childhood seem to rise sharply to a maximum and to decline fairly rapidly after the point of highest incidence. Only diphtheria and scarlet fever continue to show serious mortality rates after the period of childhood.

With the exception of whooping cough, the death rate for these diseases is higher for males than for females during the first five years of life. After the fifth year of life the mortality rates of measles, scarlet fever and diphtheria for the two sexes are not markedly different. For whooping cough the mortality rates are considerably higher for females throughout the entire period of childhood but the percentage of excess female mortality is greatest in the third year of life.

V. ACCIDENTS AND INJURIES.

Accidents and injuries are a significant group of causes of death in childhood. Burns, falls, automobile and other vehicular accidents and injuries, drowning and accidental poisonings constitute the chief single causes of accident mortality at these ages. Burns account for an appreciable percentage of the total mortality from the second to the fifth year of life. Falls play an important part in the deaths between the second and fourth year of life and show much higher mortality rates at each of the ages of childhood among males than among females. The vehicular accidents have their maximum incidence at the age period 5 to 9 years. The automobile is the chief agency in the causation of these deaths.

VI. IMPORTANT INFECTIOUS AND ORGANIC DISEASES OF MISCELLANEOUS ORDER.

There remain a miscellaneous group of diseases which we have not considered under any of the preceding five main groups of causes of death in children. This group includes the organic diseases of the heart, the acute and chronic diseases of the kidneys, acute articular rheumatism, acute endocarditis, diabetes, appendicitis, and tuberculosis, especially tuberculous meningitis.

The organic diseases of the heart first begin to assume prominence in the fourth year of life and increase in frequency up to the age period 10 to 14 years where we record the maximum rate in childhood. Diseases of the kidneys likewise are of significance first in the fourth year of life. The maximum rate for acute nephritis is found between 3 and 4 years, and the minimum between 10 and 14 years. These deaths in many instances follow the acute infectious diseases, scarlet fever chiefly. Bright's disease is of some importance in the second and third quinquennia of childhood. Chronic Bright's disease in childhood is also closely associated with the acute infectious diseases of the earlier ages but the number of deaths continues to be important in the second and third quinquennia. Acute endocarditis and acute articular rheumatism may be considered together, because of the frequent clinical association of the two conditions. We record a significant rate of mortality between ages 5 and 9 years from both of these conditions. Appendicitis is an important cause of mortality beginning with the fourth year of life and increases in incidence throughout childhood.

Tuberculosis is a leading cause of death throughout all the ages of childhood. The rate is highest in the first year of life; it decreases to a minimum in the period 5 to 9 years, and rises thereafter. Tuberculous meningitis is the chief form of tuberculosis in the first ten years of life. Tuberculosis of the lungs shows its minimum rate in the period 5 to 9 years, but beginning with the quinquennium 10 to 14 years, the mortality for tuberculosis of the lungs rises to first importance and continues to hold its place as the leading cause of death for several age periods thereafter.

CONCLUSIONS AND RECOMMENDATIONS.

The following conclusions and recommendations suggest themselves from this analysis of the mortality statistics of childhood.

There is opportunity and need for concentrating the efforts of the public health movement upon the further reduction of mortality in childhood. The work of community health agencies during the past twenty years has shown clearly the

large possibilities for life conservation when directed at the preventable causes of infant and child mortality. The reduction of infant mortality has become a definitely established part of the public health programme. Much additional saving can be accomplished by attacking especially the group of diseases which we have included under the heading of prematurity, congenital debility and malformations, etc. The extension of effective prenatal work and the provision of greater facilities for competent obstetrical and nursing aid in childbirth will accomplish very material reductions in mortality from this group of causes which constitute so large an element in the destruction of child life. Practical experience in prenatal work in a number of cities, especially in Boston, Massachusetts, has already demonstrated the exceptional opportunities for the saving of maternal and infant life which await the broadening public health programme in the United States.

The so-called "pre-school" years of childhood have as yet received very little attention from the life conservation movement. Much preventable mortality is in evidence at these ages beyond infancy and under the school years. Sickness and mortality from the acute epidemic infections, and especially from the more serious complications of these diseases, are still in evidence and constitute a challenge to our best efforts for their control. Diphtheria is still a very grave menace to child life at these pre-school years. The extensive development of child welfare clinics, patterned very much after infant welfare stations, seems to be indicated by the facts of our inquiry. While their primary function should be, perhaps, the control of nutritional diseases, the work of such clinics may well result in a reduction of the sickness and mortality rate of the acute epidemic diseases through an increase in the physical resistance of children and by the dissemination of hygienic knowledge to mothers.

The years of school life show comparatively low mortality rates; but even at this period, mortality is capable of still further reduction through additional public health welfare activities for children. There can be more complete coöperation between the medical authorities in schools and those

engaged in health conservation work outside the schools. School medical inspection and school nursing are still far from universally available for school children, especially in rural communities and in small cities. Where such medical and nursing service is available to school children, much still remains to be done to make this form of public health service more efficient and in line with practice which has stood the test of experience in the larger centers of population.

Finally, we must seek earnestly to improve our sources of information on child life. Our available records of the number and of the characteristics of American children according to single years of life are indeed faulty. This is especially true for the early ages in childhood, including infancy. Effective health work is conditioned at almost every point by the completeness and reliability of our statistical information. American statisticians, including registrars of vital statistics, and the medical profession generally, should combine all their effective forces to make birth registration once and for all reasonably complete on a nation-wide basis. Similarly we must strive to secure a greater measure of success in the enumeration of the population at the child ages in the Census of 1920. Accurate census returns of the child population of the United States, together with improved birth registration, the extension and refinement of death registration, and the critical statistical analysis of child mortality will place data at our disposal for practical service in the saving of child life, not only in infancy but at the ages of childhood as well.

PROCEEDINGS OF THE 79TH ANNUAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION, PHILADELPHIA, PA.,

December 27–29, 1917.

PROGRAM.

THURSDAY, DECEMBER 27.

10.00 a. m. First Session.

1. The Mortality Rate in Childhood, Louis I. Dublin, Metropolitan Life Insurance Co.
2. Methods of Analysing Occupational Mortality, Arne Fisher, Prudential Insurance Co.
3. Some Preliminary Results in Industrial Fatigue, Robert E. Chaddock, Columbia University.
4. Infantile Mortality Studies of the Children's Bureau, R. M. Woodbury, U. S. Children's Bureau.

Discussion.

1.00 p. m. Subscription Luncheon. All Associations. Bellevue-Stratford Hotel.

2.30 p. m. Second Session. Business Meeting.

Reports of Officers and Committees.

Election of Officers.

8.00 p. m. Third Session.

Joint Meeting with the American Association for Labor Legislation for Presidential Addresses.

Health and War, Irving Fisher, President, American Association for Labor Legislation.

Statistics in War and Peace, Allyn A. Young, President, American Statistical Association.

10.00 p. m. Reception. All associations.

FRIDAY, DECEMBER 28.

10.00 a. m. Fourth Session.

General topic: The Organization of War Statistical Work in Washington.

1. Statistical Work of the War Trade Board, Walter M. Adriance, Bureau of Research.
2. Statistical Work of the Council of National Defense, Leonard P. Ayres, Director, Division of Statistics.
3. Statistical Work in the Office of the Surgeon General of the Army, Horatio M. Pollock Statistician, New York State Hospital Commission.

4. Statistical Work of the Federal Trade Commission, L. H. Haney, Economy Board.

Discussion:

1.00 p. m. Luncheon. University of Pennsylvania.

2.30 p. m. Fifth Session.

General topic: The Vital Statistics of the War.

1. Army Anthropometric Statistics, Frederick L. Hoffman, Prudential Insurance Co.
2. Plans for the Vital Statistics of the War, John S. Fulton, Capt., Medical Section, O. R. C., Washington, D. C.
3. The Development of Medical Sanitary Statistics, Walter F. Willcox, Cornell University.

Discussion: Charles E. Brooks, U. S. Bureau of War Risk Insurance.

8.00 p. m. Sixth Session.

Statistical Units as Standards, Horace Secrist, Northwestern University.

Discussion:

Round Table Discussion of the Census of 1920, Chairman, John Koren. The Discussion will be opened by Edwin W. Kopf, Secretary of the Committee on Relation of 1920 Census to Vital Statistics.

10.00 p. m. Smoker. All associations.

SATURDAY, DECEMBER 29.

10.00 a. m. Seventh Session.

Business Statistics.

1. Internal and External Statistical Needs of American Business, W. A. Hathaway, American Telephone and Telegraph Co.

Discussion:

Internal Needs, Roland P. Falkner, Alexander Hamilton Institute, Melvin T. Copeland, Harvard University.

External Needs, Earle Clark, Du Pont de Nemours & Co.

1.00 p. m. Luncheon. Haverford College.

8.00 p. m. Joint Meeting. All associations.

MINUTES OF THE BUSINESS MEETING.

Meeting called to order at 2.30 p. m., December 28, 1917, President Allyn A. Young presiding.

The reading of the minutes of the previous annual meeting was dispensed with, since they had been published in the QUARTERLY PUBLICATIONS of the Association.

Reports were submitted as follows:

SECRETARY'S REPORT.

Mr. President and Members of the Association:

I have the following to report in respect to the condition of the Association:

Membership, December 29, 1916, last annual meeting		699
New members added		72
Deaths during year	10	
Resignations	16	
Dropped	8	
Total deductions		34
Present membership		737
Net gain		38
Besides members we have:		
Subscribers, mostly libraries		227
Domestic Exchanges		40
Foreign Exchanges		117
Total mailing list		1,121

The death of the following members has been reported during the year: James H. Blodgett, Isaac Davenport, Henry Ferguson, Henry Holton, Charles A. Loveland, Manton Marble, George W. Olney, Robert P. Porter, F. W. Whitridge, Walter C. Wright.

Three regular numbers of the QUARTERLY PUBLICATIONS have been issued, containing an aggregate of 339 pages, and the fourth number—that for December—containing about 70 pages, is now in press. The appearance of this number has been delayed by my removal from Cambridge to Washington, D. C., to enter the service of the United States Government.

Respectfully submitted,

CARROLL W. DOTEN,
Secretary.

On motion it was voted to accept the report of the Secretary and to authorize its publication in the March number of the QUARTERLY PUBLICATIONS.

Treasurer's Report.

December 22, 1916 to December 19, 1917.

RECEIPTS.

Membership dues	$1,178.18	
Sales and subscriptions	844.02	
Dividend on B. & A.	174.12	
Balance on hand	586.07	
		$2,782.39

EXPENDITURES.

Printing	$1,600.38	
Postage	120.50	
Salaries	325.15	
Expense	8.73	
Balance forward	727.63	
		$2,782.39

ASSETS.

17 Shares Boston & Albany	$2,074.00

S. B. Pearmain,
Treasurer.

Auditor's Report.

I have audited the accounts of the treasurer of the American Statistical Association, for the year ending December 20, 1917, and counted the securities in his possession. I find the accounts accurately stated and the expenditures properly vouched.

Respectfully submitted,
Martin J. Shugrue.

Auditor's Report.

I have audited the Anniversary Fund accounts of the treasurer of the American Statistical Association for the year ending December 20, 1917 and find that there were no transactions for the year and the balance on hand is correct.

Respectfully submitted,
Martin J. Shugrue.

On motion it was voted to accept the reports of the treasurer and the auditor and to publish them in the proceedings.

Report of Nominating Committee.

The report of the Nominating Committee, consisting of T. S. Adams, W. Z. Ripley and G. P. Watkins, which had been sent to the members of the Association in accordance with the provisions of the constitution, was presented for action. It was voted to instruct the secretary to cast one ballot for the following persons placed in nomination by the committee: President, Wesley C. Mitchell; Vice-Presidents, Charles F. Gettemy, Joseph A. Hill, Carroll W. Doten; Counsellors, E. Dana Durand, Charles H. Verrill, Fred C. Croxton; Treasurer, S. B. Pearmain; Secretary, Robert E. Chaddock; Librarian, Horace L. Wheeler; Editor, John Koren. The vote was cast as directed and the officers declared elected.

Report of the Library Committee.

The Library Committee, through its chairman, Roger W. Babson, reported on possible plans for the better housing and utilization of the Association Library. The report was accepted and the matter was referred to the Directors with power.

Report of Committee on Fellows.

The Committee on Fellows announce that the following regular members of the American Statistical Association have been unanimously elected fellows, in accordance with Article V of the constitution: Leonard P. Ayres, R. E. Chaddock, Willford I. King, Max O. Lorenz, A. H. Mobray, Henry L. Moore, N. I. Stone, Frank H. Streightoff, Edward L. Thorndike. The report was submitted by the chairman of the committee, Wesley C. Mitchell, and approved by the Association.

Publication of the Memorial Volume.

The discussion of the ways and means for the publication and sale of the Memorial Volume on the History of Statistics in the leading countries of the world, which, through the untiring efforts of the chairman of the Publication Committee, John Koren, is now ready, was taken up. In the discussion it was suggested that a limited edition for members of the

Association at half price be offered, in addition to the regular edition distributed through a book publishing house. The following resolutions were presented and adopted:

Resolved, That the Association refer the question of manner and means of publication of the Memorial Volume to the Directors with power, and,

Resolved, further, That the Board of Directors is hereby authorized to incur liabilities on behalf of the Association, in amount not exceeding $2,000, provided that the incurring of such indebtedness be found necessary to insure the prompt publication of this volume.

The President appointed the following Committee on Resolutions: Joseph A. Hill, Wesley C. Mitchell and William A. Hathaway, to report at a final business session on the following day.

The business meeting adjourned and the regular program of the afternoon was resumed.

A final business session was held at Haverford College, Saturday, December 29, 10.30 a. m., with Vice-President, Joseph A. Hill, presiding.

The matter of corporate membership in the Association, as a special class with appropriate fee for membership, was presented by Willard C. Brinton. After some discussion it was voted that: "It is the sense of this meeting that steps should be immediately taken to secure sufficient funds for the support of the publications of the Association."

A motion was passed, referring to the Board of Directors, with full power, the matter of securing more nearly adequate financial resources for the Association, and directing that Mr. Brinton be invited to sit with the board for this purpose. It was moved by Mr. Koren and unanimously carried, that the constitution and by-laws of the Association be so amended as to permit of the inclusion of corporate members and to provide for their duties, privileges, etc.

Resolutions.

The Committee on Resolutions, through its chairman, Joseph A. Hill, submitted the following resolutions:

1. Whereas Carroll W. Doten has faithfully served the

American Statistical Association as its secretary for 12 years and

WHEREAS, He has felt obliged on account of other duties to decline a renomination to that office,

Be it resolved, That this Association take this occasion to express its grateful appreciation of his services, recognizing that its growth and prosperity are attributable in no small degree to his untiring devotion to its interests and to the tact, courtesy, and efficiency which he has manifested in discharging the duties of his office, and

Be it further resolved, That the newly elected Secretary be instructed to transmit a copy of these resolutions suitably engrossed to Mr. Doten and convey to him the greetings, thanks, and best wishes of the American Statistical Association.

2. *Resolved*, That the Secretary of the American Statistical Association be instructed to convey to the Committee on local arrangements and to the officers of the University of Pennsylvania and of Haverford College our appreciative thanks for the hospitality and entertainment which the members of this Association have enjoyed in connection with these meetings.

3. *Resolved*, That the members of the American Statistical Association through the Secretary extend to Mr. John Koren their thanks for the valuable services he has rendered in connection with the preparation of the Memorial Volume commemorating the 75th anniversary of this Association.

ROBERT E. CHADDOCK,
Acting Secretary.

APPOINTMENT OF COMMITTEES, ASSISTANT SECRETARIES AND ASSOCIATE EDITORS.

At a meeting of the Board of Directors held in New York City, January 11, 1918, the following committees and officers were chosen for the year:

Committee on Federal Statistics: John Koren, Chairman, Thomas S. Adams, Frederick L. Hoffman, N. I. Stone, Allyn A. Young.

Committee on State Statistics: Charles F. Gettemy, Chair-

man, John B. Andrews, Louise Stevens Bryant, Leonard W. Hatch, Edwin W. Kopf.

Committee on Municipal Statistics: LeGrand Powers, Chairman, Frederick A. Cleveland, Fred C. Croxton, Louis I. Dublin, Edward M. Hartwell.

Committee on Business Statistics: William A. Hathaway, Chairman, Willard C. Brinton, Julius H. Parmelee, Warren M. Persons, Horace Secrist.

Committee on International Statistics: Walter F. Willcox, Chairman, S. L. Andrew, Roger W. Babson, Miles M. Dawson, Irving Fisher.

Committtee on Finance: Harvey S. Chase, Chairman, S. B. Pearmain, Walter E. Weyl.

Committee on Library: Roger W. Babson, Chairman, Edmund E. Day, Edward M. Hartwell.

Nominating Committee: William A. Hathaway, Chairman, Frederick S. Crum, Allyn A. Young.

Auditing Committee: Martin J. Shugrue, Roswell F. Phelps.

Committee on Fellows: Carroll W. Doten, Chairman, term expires 1918; Edward L. Thorndike, term expires 1922; Adna F. Weber, term expires 1921; Frederick L. Hoffman, term expires 1920; E. Dana Durand, term expires 1919.

Associate Editors: Louis I. Dublin, Edmund E. Day, Julius H. Parmelee, Carl J. West.

Assistant Secretaries: Louise Stevens Bryant, Philadelphia, Pa.; Henry J. Harris, Washington, D. C.; Martin J. Shugrue, Boston, Mass.

ROBERT E. CHADDOCK,
Secretary.

IMPORTANT FOR MEMBERS.

NEW PUBLICATION OF NAMES AND ADDRESSES OF MEMBERS OF THE ASSOCIATION, TOGETHER WITH CONSTITUTION AND BY-LAWS.

The Secretary is preparing copy for the publication of a revised list of names and addresses of members, together with the constitution and by-laws. Each member is earnestly requested to make any desired correction in his address, as now recorded on our files, by writing to Robert E. Chaddock, Secretary, 501 Kent Hall, Columbia University, New York City, stating the exact address to which all notices and the publications should be sent in the future. In case there is any doubt about the correctness of your present address in our files, will the members not aid the Secretary by writing *at once? This is particularly important, due to changes brought about by war conditions.*

REVIEWS AND NOTES

Statistics, by William B. Bailey, Ph.D. and John Cummings, Ph.D. The National Social Science Series, A. C. McClurg & Co., Chicago, 1917.

The editor of the National Social Science series in his preface to this new diminutive book on statistics says "The value of a knowledge of statistics grows every day in the fields of business, government and social work. Most of the books devoted to its acquirement are either intricate or too extended. This book has been written with the purpose of avoiding these difficulties."

How simple statistics would be if a good practical working knowledge of them could actually be conveyed to the non-mathematical novice in one hundred and forty seven brief pages of about two hundred and fifty words each. The task set the writers was indeed difficult and one is surprised not that they failed to produce in such brief compass a thorough schematic elementary working handbook but that they succeeded in getting so much that is good into so little, many times even working in suggestions designed to give perfection of detail.

To criticise the book is difficult. It has the merit of its principal defect, brevity. Time and time again one wishes that the writers had gone further, had given us on this point or that the rich fruits of their experience but they must always have been conscious of the limitations of space. One must consider too that the book was not intended as a work for professional statisticians nor as an elementary treatise for students but as an aid for the social workers who venture in the statistical field. To them it will undoubtedly prove profitable and helpful and much of its illustrative material is generally interesting to all who use statistical methods.

The book has nine chapters as follows: I. Importance of Statistics (four pages). II. The Field of Study (three pages). III. Gathering the Raw Material (nine pages). IV. Editing Schedules (nine pages). V. Tabulation (twenty five pages). VI. Ratios (forty one pages). VII. Averages (seventeen pages). VIII. Graphic Representation (twenty two pages) and IX. Correlation (seventeen pages).

LEWIS MERIAM.

Washington, D. C.

SICKNESS SURVEYS OF THE METROPOLITAN LIFE INSURANCE COMPANY.

The agitation for general sickness insurance legislation along lines more or less similar to that providing workmen's compensation insurance to cover industrial accidents has sharply called attention to the need of statistical data with reference to the extent and character of sickness in our various communities, data almost entirely lacking at the present time. Workmen's compensation insurance has demonstrated that a provision for indemnity is necessary to bring out the true extent of disability even when it is such that its symptoms are as objectively apparent as those of industrial accidents. Sickness being a condition of which the symptoms are essentially subjective, it must be evident that it will not be possible to get complete data without a comprehensive insurance system. That, however, is no excuse for not trying to find out all we can about the health conditions of our communities as far as at present revealed.

Recognizing this and having found by test that in their agency organization the industrial life insurance companies have very useful machinery for the collection of social statistics of various kinds, the Metropolitan Life Insurance Company has endeavored to supply something in this field by a series of community sickness surveys under the direction of their third vice-president, Dr. Lee K. Frankel, and their statistician, Dr. Louis I. Dublin. The results of the following surveys have been published:

1. Rochester, N. Y., week of September 13, 1915.
2. Trenton, N. J., October, 1915.
3. North Carolina (sample districts throughout the State), week of April 17, 1916.
4. Boston, Mass., two weeks of July 17 and July 24, 1916.
5. Chelsea Neighborhood (New York City), two weeks beginning April 23, 1917.
6. Principal Cities of Pennsylvania and West Virginia, March, 1917, with a separate study of the results of this survey in Pittsburgh.
7. Kansas City, Mo., two weeks of April 16 and 23, 1917.

The method of procedure was fairly simple and was essentially the same in all the surveys. By reason of the weekly collection of premiums from house to house the agents of the company have established a friendly, almost confidential, relationship with their policyholders who compose a substantial part of the wage-working population of the various communities studied. The agents were supplied with a simple blank on which to record the health condition of each member of every family visited. This blank showed the age, sex and occupation of each member of the family and, where sick the disease or cause of disability, duration, extent of disability, *i. e.*, whether confined to bed, and kind of treatment, *i. e.*, by physician at home, hospital, dispensary, etc. The returns were gathered under the supervision of the district agency heads and the compilations made at the home office.

The data have been carefully and ably analyzed and the results are presented in the form of tables with explanatory text. Among the phases of the sickness problems discussed are: the distribution of sickness by age, sex and condition, *i. e.*, house confinement, ambulant but disabled from work, etc., the distribution of sickness by disease or conditions and duration, age, etc., the nature of care (in this connection community facilities are discussed in some of the reports) and other salient features of the data collected. In short the authors have endeavored from the data before them to give a fair and complete picture of the conditions found. They have not hesitated as they went on to point out weaknesses in the data, though the reports of successive studies indicate an increasing confidence on their part in their results.

In the hands of the careful worker these surveys are most valuable material. Their weaknesses must, however, always be kept in mind. The method is a census method and therefore presents a cross-section at a given instant and not a complete perspective. In comparisons between communities, for example, regard should be had to the influence, if any, of the time of year of the respective surveys or any other temporary factor. From the data presented showing the number of people sick and well, brought within the census, the number of cases of recorded sickness and their duration we can make a reasonable estimate of the average time lost per unit of exposure, *i. e.*, the rate of sickness. It is open to question whether this estimate can be safely taken as equivalent to the sickness rate which would be developed through such complete registration of the same population as would occur under a sickness insurance system. Probably the greatest weakness lies in the fact that the enumerators were not physicians and were not in position to make examinations of any kind and had, perforce, to take the patient's own diagnosis of his case. On this there was no check except where the family was a recipient of the visiting nurse service of the same company.

While we have devoted considerable space to the foregoing weaknesses of the plan, they are inherent in conditions such as all pioneer workers must face. It is to be hoped Messrs. Frankel and Dublin will be permitted to continue these studies and that they will continue, as they have in successive surveys, to bring in new phases of the sickness problem as facilities offer.

A. H. Mowbray.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

In December of 1917 this Institute issued its Year Book of Agricultural Statistics for 1906–1916, which is a survey of ten years of agriculture throughout the world and is described as "without any doubt the most complete work in existence on agricultural statistics as it is the result of the most extensive and, at the same time, the most detailed research yet devoted to this study." Aside from the intrinsic importance of the pub-

lications of this Institute, it is interesting to note that it has still remained active during the World War and is probably the only one of the international organizations whose permanent staff comprising representatives of all the belligerent countries has continued at work.

The scope and contents of the Year Book may be gathered from the following excerpts taken from the official circular of the Institute:

Comprising over one thousand pages, the 836 statistical tables are replete with every sort of information upon the subjects considered, thus establishing the volume as one of the highest importance. The number of agricultural products embraced is very large and those of tropical countries have received as much attention as the crops of the temperate zones have secured. In due sequence are furnished all the available data regarding areas cultivated in each country, the total yields realized, and the yields obtained on a given standard of area. Besides all this the Year Book includes the five years' and ten years' averages for the period included, so that readers can ascertain at a glance whether in any particular year cultivation has extended or has been restricted in a given country and whether the results have been favorable or the reverse. . . .

We find that the ascertainable annual yield of wheat throughout the world exceeds a thousand million quintals, and represents at present value, more than two thousand millions sterling; the yield of maize is nearly as large as that of wheat and is worth one thousand millions sterling, while the aggregate value of the six chief cereals (wheat, rye, barley, oats, maize and rice) is not less than six thousand millions sterling, or thirty billions of dollars, yearly.

The yield of potatoes is over fifteen hundred million quintals, and that of sugar beet is more than five hundred million quintals. Every year the world has at disposal a total of one hundred and fifty million quintals of beet and cane sugar, nearly one hundred and fifty million hectolitres of wine, ten million quintals of coffee, more than eight millions of leaf tobacco, nearly one million quintals of hops.

Textile industries account annually for nearly fifty million quintals of cotton, eight millions of flax, seven millions of hemp, while silkworm breeders in Europe and Asia deliver to the trade more than two hundred millions in cocoons. The raw material for vegetable oils comprises yearly throughout the world an aggregate of thirty million quintals of olives, and a similar quantity of linseed, four millions of hempseed, and five millions of rapeseed.

Turning to live stock, we find in the Year Book, for each of the ten years comprised, the numbers of horses, asses, cattle, sheep, pigs, etc., in eighty-two countries taken singly, and afterwards reckoned out as compared with each thousand inhabitants of the country, both at the opening and at the close of the period under review. . . . It appears that in Uruquay there are eight head of cattle to each inhabitant, in Argentina more than four head, in Australia more than two head, and throughout South America about two head per inhabitant, while in the United States and Canada there is one head of cattle per person, and in Europe only one to two persons.

Having given, by means of a large number of tables, the imports and

exports of the products previously considered as to yield, and showing the origin and destination of these imports and exports as regards each country, the Year Book takes up the question of consumption, also for each country. It is worth while to note that the consumption of wheat per head of population is extremely large in Australia, in Canada, in France, in Argentine, etc., while it is very limited in Japan, British India, Egypt, Sweden, etc., as the inhabitants of these countries live chiefly upon rice, maize, rye or other articles of food.

The prices of the chief products, on spot and for forward or future delivery form a special chapter, where readers will find all the data for a detailed examination of the marked fluctuations in recent years, inasmuch as weekly quotations are recorded in respect of the chief products. This chapter comprises tables of rates of freight and of exchange.

Then follows a chapter on fertilizers and chemical products employed in agriculture, including the data of production, trade and consumption, with the quotations, for phosphatic, potassic and nitrogenous fertilizers, for sulphur and sulphate of copper. . . .

At the conclusion of the Year Book there is a special chapter where readers can ascertain the authority for each of the data, and are thereby enabled, if they so desire, to consult these authorities and to verify the figures.

The volume is to be obtained at the *Service des abonnements et publications de l'Institut International d'Agriculture, Villa Umberto, Rome, Italy.* Price $2.